The Builder.

VOL. XLVIII. No. 2200. SATURDAY, APRIL 4, 1885.

ILLUSTRATIONS.

New Admiralty and War Offices: Whitehall and St. James's Park Fronts (Revised Design) 482-487
Roof of Westminster Hall.—From a Drawing by Mr. F. T. Dollman 490-491
Design for a Municipal Mansion: Perspective View and Detail of Portion of Towers (East Front).—By Mr. A. A. Cox 494, 495

CONTENTS.

Harbours and Docks 471
Stoneworking Machinery. By M. Powis Bale 472
Notes 473
Street Paving 474
Letter from Paris 475
Some Celebrated Timber Roofs (Illustrated) 476
On Dry Rot in Wood 480
New War and Admiralty Offices: Revised Design 480
The Roof of Westminster Hall 480
Design for a Municipal Mansion (with Plan): Soane Medallion Competition 497
Architectural Association: Visits to Fishmongers' Hall and Merchant Taylors' Hall 497
The London and Middlesex Archæological Society 497
A Suggested Site for the Re-erection of Temple Bar 497
Coloured Portland Cement 498
"Street Architecture of London" 498
"Arsenic and Architects" 498
Books: Miller's Glass Painting (Wyman) 498
Variorum 499
Church-Building News 499
The Student's Column: Descriptive Geometry.—IX. 500
Recent Patents 501
Recent Sales of Property 501
Meetings 501
York Architectural Association 502
Miscellanea 502

Harbours and Docks.

MR. VERNON HARCOURT has done some injustice to himself, as well as to his future readers, by giving to a useful book * a title which is not fairly descriptive of its contents. Most readers of the title given above would expect something like a bird's-eye view of the harbours and docks of the world, or, at all events, of those of the United Kingdom. How far that is from being presented by the work may be judged from the simple statement that while 588 ports and harbours are enumerated, in a Parliamentary Return of 1874, as existing in the United Kingdom, of which seven are military ports, Mr. Vernon Harcourt only indexes sixty-nine harbours, of which twenty-four are on our own coasts. Of the above-mentioned ports, seven were under the authority of the Admiralty, three under that of the Board of Trade, one under the Woods and Forests, eight under the Irish Board of Public Works, forty-seven are held by railway companies, twenty-five by other companies, fifty-three are owned by private individuals, and the remainder are under the control of Commissioners or Local Boards. It is thus evident that a book containing descriptions of so small a number of harbours as we have above indicated has little claim to the ambitious title of "Harbours and Docks."

What the volume really is, however, as stated in the preface, is an attempt at the exposition of the principles and practice of hydraulic engineering, as applied to the construction of harbours and docks. Thus regarded, it is a compilation of merit and utility, and that all the more so because it is not limited in its facts (as was the case almost wholly in the book on rivers and canals by the same author) to published and accessible data, but contains the pith of communications made by the engineers of several of the principal works cited. Thus, M. Alexandre, engineer of the port of Dieppe; M. Guillain, engineer of the ports of Calais and of Boulogne; M. Eyriaud des Vergnes, engineer of the port of Dunkirk; Mr. W. D. Cay, harbour engineer of Aberdeen; Colonel Mansfield, engineer in charge of the Galveston jetties; the engineer-in-chief at Delaware; M. Prevés, one of the engineers at Algiers; M. Barret, engineer at Marseilles; M. Pettit (we think it should be M. Petit), engineer in charge of the Artha breakwater; Mr. Messent, engineer of the works on the Tyne; Mr. Hayter, one of the consulting engineers to Murmagoa harbour; Mr. Druce, engineer in charge of Dover harbour works; and Major Lydecker, engineer in charge of the harbour works at Chicago, have furnished plans and details with which Mr. Vernon Harcourt has enriched and illustrated his seventeen chapters on harbours; while his own experience, already given in a paper in vol. xxxvii. of the Proceedings of the Institution of Civil Engineers, has furnished the author with the particulars that he gives as to the Alderney harbour. The chief value of a work of the kind lies in the authentic information thus collected from original sources.

After three chapters on winds, waves, and currents, Mr. Vernon-Harcourt divides harbours into estuary harbours, harbours with back-water, harbours partly sheltered by nature, harbours protected solely by breakwaters, and peculiar forms of harbours. Had the subject been approached on the side of the general importance of seaports, the first rank would have been assigned to those noble natural harbours, such as Milford Haven, Falmouth, Cork, and, we may add, the Thames, which distinguish the shores of the United Kingdom. Of these, however, we find but little,—a great defect in a general work, but consistent with the plan of a book that deals almost exclusively with the work of the engineer in those places where nature has not herself provided for the need of the navigator. Of Queenstown Harbour (Cork) there is indeed a partial plan on plate 12, but it shows only Haulbowline Island and a basin in progress, and not the magnificent expanse of sheltered water in the bay. In fact, Queenstown is mentioned, not as a harbour, but as a dockyard. Pembroke Dockyard, which, in the event of a naval war, would probably form our most important arsenal, we have not found referred to in the book.

After describing jetties and breakwaters, Mr. Vernon Harcourt gives two chapters on the different modes in which harbours are protected by the engineer, as matter of practice. He enters, at much detail, into the difference between rubble mound breakwaters, rubble and concrete-block mound breakwaters, harbours protected by sorted rubble and concrete block mounds, with slight superstructures; harbours protected by a rubble mound and a superstructure founded at low water; harbours protected by sorted rubble and concrete-block mounds, with superstructure founded at low-water; harbours protected by a rubble mound and a superstructure founded below low water; harbours sheltered by upright wall breakwaters; and harbours on sandy coasts. No doubt, minute as the differences thus indicated may seem to be, we have here indicated so many true species of one genus of harbours. But we think there can be little doubt that, as a general rule, the whole of these compound forms of breakwater are likely to be displaced by the use of the method adopted by Mr. Abernethy at Fraserburg, and the north pier at Aberdeen. The mode of construction there used is as follows:—Bags of liquid concrete of from 80 to 100 tons weight are dropped from hopper barges up to the level of low water. These bags form a solid mass of concrete or an artificial sub-marine ledge of rock. Rubble foundations are entirely dispensed with. Above low water temporary frames are placed for a length of 25 ft. or 30 ft., and the concrete is tipped into these frames *en masse*. In the course of five or six weeks the whole becomes a solid mass of concrete, upon which the sea has no effect. The pier at Aberdeen has been finished for nine or ten years, and has resisted very heavy seas during that period. A pier at Newhaven has been constructed on the same plan. The cost is very much less than that of any other method of construction, and the time necessary for completing a given length of breakwater is also greatly reduced.

The only hesitation which the engineer can feel as to the general adoption of this improved method of breakwater construction is owing to the low specific gravity of the artificial rock thus formed *in situ*. The ordinary weight of cement concrete is about 17 ft. to the ton, or not much more than double the specific gravity of water. This is a serious evil when violent seas have to be resisted, as mere multiplication of the bulk of the wall does not compensate for the low resisting power due to the small preponderance of weight. To this fact are due all the failures of concrete in harbours, according to our opinion. In the case of the Madras Harbour this source of danger was pointed out in the columns of the *Builder*, at the time of the serious damage effected by a storm. But the most remarkable case in point is that of the concrete monolith at Wick harbour. This enormous mass, of 800 tons in weight, bolted and bound to foundations, making a total weight of 1,350 tons, was washed away, under the eyes of the resident engineer, removed *en masse*, and found resting entire on the rubble at the end of the pier, having sustained no damage except a slight fracture at the edge. This event, to which Mr. Vernon Harcourt refers, took place on the 18th of December, 1872; and the particulars cited are taken from a report by Messrs. D. & T. Stevenson, the engineers to the work, dated 14th February,

* Harbours and Docks: their Physical Features, History, Construction, Equipment, and Maintenance, with Statistics as to their Commercial Development. By L. F. Vernon Harcourt, M.A., M.Inst. C.E. Oxford: Clarendon Press. 1885.

1873. There can be no doubt that, although the fury of the sea in Wick harbour is exceptional, its effect on such a mass is calculated to raise grave doubts as to the absolute reliability of concrete for breakwaters.

The reply, however, is that there is concrete and concrete. We have cited the specific gravity of ordinary concrete, and it may be admitted that it is too low to be relied on in cases where the action of the sea is violent. But at Swansea Mr. Abernethy made concrete blocks of copper slag, an extremely heavy waste material. Of this concrete from 12 ft. to 13 ft. weighed a ton. This is about the specific gravity of magnesian limestone, of serpentine, or of grey granite. It is a little more than that of carboniferous limestone. Syenite, or red granite, weighs from 15·2 ft. to 12·1 ft. to the ton. Thus, by the use of a material obtainable very readily, and of which the cost will be little more than that of transport, the engineer is provided with the means of forming a monolithic mass of any size that he may require laid *in situ* under water, and endowed with a weight which, in that case, means a power of resistance equal to that of ordinary building stone, and is only exceeded by the rarer and more costly forms of marble or of granite. We think, therefore, that the days of mounds of rubble, sorted or otherwise, of concrete blocks, and of the various kinds of compound breakwater, ably and carefully described by Mr. Vernon Harcourt, may very possibly be regarded as numbered.

A separate volume contains sixteen folded plates, each comprising numerous figures. They are clearly drawn and beautifully printed, and afford ample illustration of the text. There are also twenty-seven woodcuts printed with the text. Of these we call attention to the curves showing the relative duration of winds from different quarters at Havre and at Marseilles; and to the diagram showing the tonnage of vessels entering eighteen of the principal ports of the United Kingdom in each year from 1873 to 1883. With regard to this diagram, however, it should be remarked that while the tonnage entering the Port of London with cargo is stated at 11,500,000 tons, that entering Liverpool being given as only a little over 8,000,000 tons, the "Statistical Abstract" for 1883 gives the following figures. Tonnage of vessels, British and foreign, sailing and steam, that entered with cargoes and in ballast in 1883:—London, 6,589,594; Liverpool, 5,467,274; ditto cleared, London, 4,810,680; Liverpool, 5,167,568. This agrees with the rank given to those two ports in the table on p. 630, but it seems to us quite irreconcileable with the diagram on p. 628. Even taking "Tonnage of vessels entering ports" to include both entrances and clearances, London is only 765,000 tons in excess of Liverpool, instead of nearly 3,500,000 tons, as shown on the diagram. This is a matter demanding explanation, in a book which we have found to be generally accurate. We suppose that Mr. Vernon Harcourt has included coasting traffic, which is not given by the "Statistical Abstract"; but, even so, the proportions given in his diagram, and in Appendix V., differ so materially from the figures cited by Mr. Thomas Stevenson in his standard work on "The Design and Construction of Harbours," as to call for clear explanation, as well as for definite citation of authority. The form of diagram employed, if made to show both entrances and clearances, of both foreign and coasting trade, distinguishing each at each of the thirty-seven ports specified in the "Statistical Abstract," would afford interesting information; and might form a basis for a general comparison of the harbours and docks of the United Kingdom.

Pottery Exhibition at Delft.—The Delft Section of the Netherlands Society for the Promotion of Industry will open an International Exhibition at Delft, on the 1st of June, 1885, to be devoted to Ceramic Tiles and Stained Glass. The Exhibition will remain open until the 31st of July. Applications for space must be made to the secretary, at Delft, before the 15th of April, and exhibits must be delivered before May 15.—*Journal of the Society of Arts.*

STONEWORKING MACHINERY.

BY M. POWIS BALE, M.I.M.E., A.M.I.C.E.

ALTHOUGH the conversion of stone is one of the most ancient of all the mechanical arts, its conversion by means of machinery, in an advanced form, is quite of modern origin. A few years since, owing to the high rates of wages in vogue, operative masons' strikes, and other causes, a very considerable impetus was given to the development of this branch of engineering; however, in consequence of the continued depression in everything relating to the building industries, the introduction into more general use of machinery for the conversion of stone has been very slow. This may be partly attributed to the fact that in one or two cases machinery was erected in which the principle of working was ill-adapted to the nature of the stone operated on, and partial failure was the result. There can, nevertheless, be but little doubt that, by judicious selection, machinery can be made to effect an immense saving over hand-labour.

In the first instance, it is important that the stone it is desired to work be suitable for machine conversion. Most kinds of stone can be sawn without much difficulty, but when they are required to be dressed to a fine surface, or moulded, difficulties varying with the character of the stone present themselves. Stones of the nature of Portland, Bath, York, and Caen, and most kinds of freestones, can be readily worked by machinery if they are tolerably free and even in texture and hardness. Hard grit stones or flag paving, magnesian limestones, and oolites may be dressed to a plane surface. Granite also can be dressed to a plane surface. Slate, unless it be rotten or shaly in its character, may be worked by machinery with facility.

Stones which contain much shelly fossil deposit, especially if this be hard and crystalline, are unsuitable, as also are very tender stones. From a casual inspection of a stone, however, it is impossible to say with certainty whether it will work or not; the best way is to try it practically. Within the scope of this article it will be impossible to do more than glance at one or two of the most advanced machines for sawing, dressing, and moulding purposes.

For rapid sawing of the softer stones used in building construction, the circular saw has quite out-paced the ordinary horizontal blade, as with a well-constructed machine of this class from 150 to 250 running feet can be cut in a day of ten hours; if two saws are mounted they can be used for squaring the faces of the blocks at the rate of from 3 in. to 9 in. run per minute, and for this purpose they are of very considerable value. The advantages in favour of the horizontal blade are lower first cost, and rather cleaner work. In connexion with circular saws for stone conversion the most important point is the construction of the teeth; these, which are usually "false," should be of simple form, and easily and cheaply renewed. After repeated trials we can recommend those with the head of the tooth forged into a cupped or trumpet form; they should be made from the best rod steel, turned at the cutting edge, and hardened. One of the advantages of this form of tooth or cutter is, that when its edge is dulled or chipped it can be turned in its socket so as to offer a fresh cutting margin, and as it wears away on the advancing side, the tool will offer several fresh cutting faces before it is entirely worn out. The tool should be made sufficiently long, so that it will allow of its head being softened, again set up, turned, and hardened. As regards the cutting speed of circular saws for stone, no arbitrary rule can be laid down, as this must depend on the nature of the stone operated on. A speed at the periphery of from 50 ft. to 200 ft. per minute, or with a cutting-speed varying from 3 in. per minute in hard stone up to 12 in. in soft stone, will be suitable. The cost of tools for cutting, say 200 ft. run of sandstone, should not exceed 5s.

In cutting very difficult stone, such as that containing pyrites, the cutting-tools should run very slowly indeed, say 40 ft. traverse at the periphery per minute, or they will be found to heat red-hot, and will, of course, at once be rendered useless; the feed should not exceed 2 in. per minute. Some difference of opinion exists as to the advisability of sawing stone with circular saws, with or without water. Some stones can, without doubt, be readily sawn dry, but from our experience we prefer wet sawing, as it keeps the tools cool and prevents unnecessary dust. In cutting stone with circular-saws the strain on the saw spindle and bearings is considerable; they should, therefore, be strongly supported by massive side standards, and the bearing surfaces should be ample; the whole framework of the machine should be of massive construction, to overcome excessive vibration in working. Should there be a jar on the saw-teeth in working, they will be found to deteriorate much more rapidly, and the work turned out will be "galled," and not so true on the face. With a well-constructed circular-saw the stone should leave the machine sufficiently true to enable it to be bedded or jointed without further preparation, either by hand or on the planing-machine, or rubbing-bed. For rapidly squaring large blocks of stone for harbour and similar works, circular-saws will be found especially valuable, and, as they become better known their use should be largely extended. For dividing very large blocks, two circular-saws, placed one above the other, but working in the same vertical line can be used. For joining flat stones, such as paving, all hand-labour may be saved by mounting two saws so as to trim two edges and make them parallel, and by reversing the stone and setting it square by these sides, the other edges may be served in a similar way.

Although the advantage of machine conversion over hand-labour in stone-sawing is considerable, it is much greater in the case of stone-dressing and moulding-machines. In the early machines it was attempted to imitate mechanically the action of the mason's chisel or quarry axe, but the whole of these devices have been failures. The principle of working that has proved most successful in dressing plain surfaces on stone is that of circular rolling cutters, and for moulding stone, a combination of revolving cutters and stationary scraping tools.

For dressing plain surfaces the circular cutters are given a determinate rotation on their own axes at the same time that they are carried round in a circle. It is found that with a nicely-adjusted rolling action there is very little attrition between the stone and the cutter, and that this is chiefly due to the forward movement of the stone; at the same time little heat is produced, and the cutter-edge wears away very slowly. The principle of working may be stated as a rolling pressure brought to bear at the base of a certain portion of stone with the intent to force it off. These cutters are made of chilled cast-iron, or, for working the harder kinds of stone, of chilled cast-steel; the cost of renewal is small. A variety of machines has been constructed, in which a number of tools of various types, having a circular movement in a plane parallel to the face of the stone, are employed. To successfully work these mechanically over the face of a stone may not appear very difficult in theory, but in practice we invariably find, when a large number of tools are employed, that they vary in wear from difference in temper, material, or from the work they have to perform; and this is, without doubt, one of the chief reasons of the failure of this class of machines, whether for working stone, wood, or other material.

The amount of stone that can be dressed on the best type of machine will depend largely on (1) the nature of the stone being worked, (2) the size of the blocks, and (3) the way in which the machine is kept constantly supplied with stone. With the ordinary stones used in building construction, of a moderate degree of hardness, a fair average would be about thirty superficial square feet per hour, premising, however, that only a moderate amount of stone had to be removed. The cost of this, allowing two men and one boy to supply stone and attend to the machine, would amount to about

2s., whilst an average price to dress the same by hand would be about 5s., leaving a large profit and surplus for contingencies. These prices would, however, vary somewhat in different localities.

Passing to stone moulding machines, in the most advanced type the stone is subjected to the action of both revolving and scraping tools. The mouldings are roughed out by small trumpet-shaped steel cutters, similar to those already mentioned as being used in circular sawing; these are mounted horizontally in flat tool-holders, arranged in rotation on vertical spindles, the sizes of the tool-holders being graduated according to the depth of the various members of the moulding. For scraping and finishing the stone to the desired outline, flat profile steel cutters are used mounted in tool-holders, with vertical and horizontal adjustments, so as to bring the tool to act either on the side or upper surface of the stone, as may be required. For working under-cut mouldings the table carrying the stone is made to swivel, or the stone can be mounted in a cradle. For moulding and surfacing semicircular windows, and such like curved work, a revolving table is generally employed. For holding shafts and pillars in position whilst being moulded or dressed, adjustable head-stocks are used.

For "checking" deep mouldings, a circular saw may be used with advantage. This is fixed on the top of the other tool-holders, and penetrates into the stone before the cutters following it come into play. In moulding stone, all complex forms of cutters should be avoided; and many members of the same moulding should not be formed on one cutter, except for scraping and finishing purposes, and the temper of the tool should be adjusted according to the hardness or nature of the stone being worked. In making bevelled mouldings, the stone should, if possible, be sawn to an angle before being put on the machine, as the cutters, having thus less material to remove, are subjected to less strain and consequent wear. At the same time, the stone is less liable to "pluck" in the working, or break at the arrises. For moulding purposes I am in favour of using a combination of revolving cutters for roughing out, and stationary scraping cutters for finishing, in preference to two sets of stationary cutters. The dead contact of the roughing cutters with the stone being less, the friction in working and the power required to drive are reduced in proportion. The arrises, too, are less liable to break. In the successful application of stone-working machinery, in addition to the principle of working being suited to the material, the speed, temper of the cutters, and the rate of feed must be adapted to the nature of the stone, as what may be right in one case may,—owing to the varying character of the material operated on,—be entirely wrong in another. For example, some stones may be cut or forced off in large chips, whilst others have to be almost scraped or ground away.

With a suitable machine a large range of work may be turned out, such as architrave mouldings, cornices, ovolos, pilasters, astragals, ogees, scotias, string, and other straight, undercut, and curved mouldings, and these are much superior to hand-work, both in the sharpness of the outlines and in accuracy of finish. The amount of work that can be performed will, of course, vary with the section of the moulding, the size and nature of the stone, and the number of changes of work. The following statement of work done by a duplex-barrel moulding machine was taken by the writer from the time-book of a machine working in Portland stone on a large contract:—String, 1 ft. deep, 7 in. projection, 50 ft. run per day of twelve hours; window-jambs, 6 in. face, full of mouldings, worked both sides, 150 ft. run per day; moulded steps, twenty-four per day, worked both sides, with four steps on the machine at one time. As in different localities the conditions will vary,—owing to the varying nature of the work and the prices paid,—it is a somewhat difficult task to compare the cost of hand and machine moulding work by absolute figures. Our practical readers will, however, be able to form their own opinions in this matter. Let us take London prices, and say about 90 superficial feet of Portland moulding be worked on a machine in one day, at an outside cost of 30s.; at the ordinary price of London hand-labour, 90 ft. of Portland moulding, at 1s. 2d. per foot prime cost, would amount to 5*l.* 5s. 4d., which leaves a very large margin for profit and contingencies.

Another advantage that machine-moulding will be found to have over hand-moulding is that the work is better done, the lines being perfectly straight, and the edges beautifully sharp, and should a large number of pieces of one moulding have to be worked they will be found absolutely alike in section.

In concluding these notes, the successful operation of stone-working machinery as a financial investment may be said to depend on the following points:—(1) The suitability of the stone; (2) the suitability of the machine, the tools, and the principle of working; (3) the constant supply of material to be worked; and these points being secured, in these days of high wages, short hours, and extreme competition, few industrial operations can show a better return.

NOTES.

THE first trumpet-blast to herald the approaching Indian and Colonial Exhibition for 1886 was sounded on Monday last, when the Royal Commission to organise the Exhibition met for the first time at Marlborough House, under the presidency of the Prince of Wales. The Prince referred to the attractive display of Indian art at the Paris Exhibition of 1878, which could only be witnessed by a comparatively small number of the population of these islands; and there can be no doubt that the proposed Indian Exhibition on English ground will be a matter of the greatest interest not only in an artistic sense, but to some extent in a political and social sense also. The Government have not so far signified any intention of making a grant in aid of the Exhibition, though entirely approving of it. It seems desirable that some definite and substantial aid should be given by Government for an Exhibition of which, owing to the cost of transport, the expenses will certainly be abnormal, and which is of quite exceptional and national importance. A guarantee fund has been formed, to which the Indian and Colonial Governments have contributed 51,000*l.*, and the Prince had to acknowledge the cordial response made by Corporations, firms, and individuals in the United Kingdom to invitations to participate in the guarantee. The buildings which have already been used for the Fisheries and Health Exhibitions have been placed at the disposal of the Commission on fair terms, and plans of them showing the available space have been sent to the Government of India, the High Commissioner for the Dominion of Canada, the various Agents-General of the Colonies, and, through the Colonial Office, to the Crown and other Colonies, and have met with their approval. An important variation from the usual conduct of such exhibitions is that no award by juries is to be given, but only a commemorative medal to each exhibitor. The object of this, as explained by the Prince, is that as some colonies, from their age and circumstances, were more advanced than others, those in their infancy should not be placed at a disadvantage in an exhibition from which all thought of trade rivalry will be excluded. This is, we think, an entirely desirable regulation; indeed, one may say that awards of juries in many large exhibitions of the same kind have been scattered so thickly as to lose their real value, and have been "worked" so hard by those who have obtained them as to give a most disagreeably advertising character to exhibitions promoted with no object of the kind. The details of the executive duties will devolve on Sir Philip Cunliffe-Owen, and a special Finance Committee has been appointed, consisting of Sir John Rose, Sir George Birdwood, Mr. Edward Birkbeck, Sir Barrow Ellis, and Sir William Sargeaunt.

PROFESSOR LEONE LEVI has published some important addenda to his report on the wages and earnings of the working classes, which was reproduced in the *Times* in January last. The estimates then given of the value of wages came down, at the latest, he now tells us, only to the middle of last year, and the Professor is of opinion that the reduction which has since taken place must amount to fully 15 per cent. on the rates of wages in the leading branches of the industry of the country. As the year 1867, from which the comparison starts, was one in which wages had fallen by at least 5 per cent. from the rate of 1865, the reduction intimated is very serious. Mr. Levi does not state how far the 10 or 15 per cent. reduction now under debate in so many parts of the country (as shown in our last number), is included in his estimate. But it is evident that his stated advance of 12·37 per cent. in the rate of wages per wage-receiver from 1867 to the middle of 1884 is altogether swallowed up by the admitted decline,—to say nothing of contingent reductions. And it must be borne in mind that rent, taxation, and almost all the expenses of life are steadily on the increase, and must and do increase with the increase of population. Unless, therefore, the rate of wages increases in a corresponding manner, the working man is steadily getting worse off. And this ought to be regarded with due attention by those who would compare (without bearing expenditure in mind) the wages at any former period of our history with those now paid, when they are paid.

CORRESPONDENCE in *re* the Westminster Hall Restoration, resumed itself in the *Times* on Friday, last week, in the shape of two letters from Sir Edmund Beckett and Mr. Butterfield. The former is very much more to the point than he sometimes is, though it may be questioned whether the whole merit of the architectural models is his because he talked about them before, and we may reasonably feel perplexed at being told that "all the Gothic styles used straight parapets" and not battlemented ones. Has Sir E. Beckett, at one blow, dismissed the Perpendicular style with costs, or how? We quite agree in disliking battlemented parapets, because they are a weak and trivial survival of a form really belonging to military engineering, and unmeaning when used as an architectural ornament. Sir E. Beckett recognises the cogency of Mr. Brewer's evidence as to the former state of the site, and that the Hall never could have been outwardly seen from the westward.

MR. BUTTERFIELD thinks the small windows very mean in appearance, but considers this a secondary matter compared with the manner in which the effect of the flying buttresses has been interfered with. "They are cruelly treated by the high-shouldered walls which are made to abut upon them, and I trust that any member of the House of Commons who intends to give a vote upon the subject will first survey, from Poet's Corner, the one buttress of the Hall which has not yet been disguised. The faults which must be felt to belong to the Hall itself are aggravated by the model, while such good points as the peculiar character of these buttresses in their isolation are overlooked, misunderstood, and destroyed." Mr. Butterfield urges that we can only do justice to the buttresses by leaving them in their isolated condition, showing fully the fine outline of their arches. We should not object to a low cloister between the buttresses, which rather seem to want connexion in their lower portion, provided the upper portion and the flying buttresses are left free. The built-up models, the higher one at all events, if carried out, would simply involve the spoiling of the effect of the architecture (if it should remain permanently visible) for the sake of a piece of archæological trifling. Mr. Butterfield, by the way, has the courage to suggest that both the value of the Norman masonry and the possible damage to it (by being left exposed) "have been perhaps a little exaggerated." We should be disposed to say so too. This is probably the only age

in architecture in which people would have gone on their knees in this way to an old remnant of wall, and worshipped it. Preserve it by all means; but do not make an idol of old stones,—even Norman ones. In reference to this point the "Society for the Protection of Ancient Buildings" circulate a pamphlet on the question, in which the solemn fetish-worship paid to this remnant of Norman walling really approaches the borders of lunacy.

RAVENNA is not usually accounted a lively place, but, in the matter of Byzantine archæology, the local *savants* show a praiseworthy energy and zeal. A museum is in process of formation in which it is intended to gather together all the fragments of architecture, sculpture, metal-work, &c., which are constantly coming to light in the neighbourhood, and which have been hitherto so scattered as to be only available with great difficulty for scientific purposes. The collection is to find a home on the ground-floor of the Ravenna Library, and is to be under the directorship of the sculptor Henrico Pazzi. It is hoped that at the end of the present year it may be available to the public. At present all is in confusion, but even a passing glance shows that the material is valuable and abundant. Some generous owners have presented their discoveries to the museum; the possessions of others are only on loan, and are labelled with their owners' names. Noticeable among the scattered monuments massed together in disorder are a beautiful fragment of a cornice found in the courtyard of St. Vitale; two capitals, provenance unknown; one side of an altar of the sixth century with a delicate column and capital as support, found by a countryman while digging; and another capital of wonderful intricacy, found in the garden of the Archbishop and lent by him.

PHOTOGRAPHY has done wonders for the preservation of at least the memory of some monuments which cannot, as yet, be removed and placed in the museum. Part of a beautiful arch, originally belonging to the ciborium of the Church of San Pietro, in Bagnacavallo, a work of the fifth century, lay for a long time unnoticed and trodden upon in the pavement. It has been photographed, and is now, though in part defaced, rescued from further destruction by being placed in the wall of the church. Another fragment of a tympanum has been found, built in beneath a column in S. Francesso, and has been photographed, but from its position cannot be moved. Sometimes the Museum finds that its action comes in too late; for instance, a Byzantine capital, found in Ravenna, was sold to a dealer, and resold to the architect who was at the time restoring S. Stefano at Bologna, where it now stands. Owing to the marshy position of Ravenna, draining operations have constantly to be carried on, and it is in course of these works that monuments frequently come to light. Smaller objects of interest in the museum are two metal crosses adorned with extremely rude Byzantine work (both found in the Duomo behind a sarcophagos),—a beautiful necklet of pearls and gold work of the sixth century, found during excavations in the crypt of S. Francesso, and some coins and weights of coarse workmanship. Scarcely less valuable than this work of collecting scattered monuments in the museum is the systematic reproduction by photography of sculptured and architectural details either too remote for convenient personal inspection or exposed to decay from the action of the weather. Sig. Ricci has just recently made a series of photographs of the decorative details of the tomb of Theodoric. Casts of the original are taken, and the photographs are made from the casts, the result being that the student gets a clearer notion from a study of the photographs than from the actual monument itself, unless he be provided with scaling-ladders. The photographs, it is understood, are taken with a special view to the publication of this monument in a work hortly to appear in Berlin.

IN a recent report on the condition of the sewers in the district of the Local Board of Health of Bromley (Kent) Mr. Rogers Field makes some special observations in regard to the causes of offensive smells from sewers. The sewerage in the district being on the separate system, and the population rather scattered, the flow of sewage is small; and though the sewers are generally well laid, there are slight irregularities in jointing, of little consequence where a good flow is passing down the sewers, but sufficient to arrest sewage matter when the flow is small, and lead to an increasing accumulation. With frequent flushing this accumulated matter would be washed away before it has time to putrify, and the smells would be only those due to fresh sewage; with infrequent flushing the evil would obviously be much greater. The smell from putrid sewage, Mr. Field observes, is undoubtedly dangerous, that from fresh sewage is not. Another defect which Mr. Field notices as exemplified in the Bromley district sewerage, and one to be guarded against, is bad construction of the open some cases these were rough in surface finish, channels at the bottoms of manholes. In thereby arresting solid matter; in some cases the channels have sunk so as to form small basins for the collection of sewage. No wonder in such a case a bad smell should find its way through the grid of the manhole. Another point noted in the report is that the sewers are all the same size,—12 in. diameter. The one which has the greatest duty to perform never runs more than one quarter full: consequently those which have less duty must be too large, to the peril of the proper flow of the sewage.

THE annual loan exhibition of pictures at St. Jude's Schools, Whitechapel, is open this week and next, and is attracting large attendances in the neighbourhood. Visitors from the West may find an opportunity of renewing there their acquaintance with some notable works. There is Sir F. Leighton's large "Alcestis," the struggle of Hercules with Death, and Mr. Watts's "Britomart" and "Esau," and the "Meeting of Jacob and Esau"; Mr. Crane's "Allegory of Human Life," which may be remembered in the Grosvernor Gallery; a very fine selection of the works of Israels; Mr. Poynter's "Zenobia" and "Helen"; a considerable number of small but beautiful sea pieces by Mr. Brett, and many other works by eminent painters. There is one remarkable picture by Mr. G. F. Watts, which has never before been exhibited,—"Godiva,"– not the ordinary "nude study" affair to which that title generally introduces us, but Godiva fainting and helped off her horse by her women at the close of her ordeal, with a countenance almost painfully expressive of mental strain and suffering. Mr. Watts never takes an old subject of this kind in hand without giving a new and deeper reading to it.

THE annual exhibition at Mr. Wallis's Gallery, which opened to the public this week, is rather above than below the average of the exhibitions at this gallery. There is a fine Meissonier (10), which in itself is something to say, for Meissonier has not been frequent of late in English exhibitions. There is a very fine Gérome, "Botzaris" (33), a single figure enthroned amid beautiful decorative surroundings; there is a fine example of Corot also. To name these three (though none of them are new works) is enough to make the exhibition, if the rest of the walls were bare. Professor Müller sends "Bazaar Street, Cairo" (15); Herr Heffner has some fine works in his last manner, but it is becoming more and more evident what a decided mannerist he is. The two other large pictures are not highly successful; one by Révész (a new contributor) represents "Sandor Petöfi" (108), a poet, who is called the Burns of Hungary, and is a very Hungarian Burns indeed, reciting in a theatrical manner to a theatrical audience; and of the other, "The Genius of Pity staying the Vivisector's Hand" (88), surely the title of the picture and the name of the painter (Gabriel Max) are enough. If Mr. Wallis is to keep up the æsthetic standard of his gallery he should not let that sort of thing in. There are numerous good works by Chevilliard, Laugée, Van Marcke, A. Holmberg, Allan Schmidt, Seiler, E. Frere, and others.

THE exhibition of the works of deceased water-colour artists collected by the Royal Society of Water-Colours Art Club, which was open for a few days at the rooms in Pall Mall East, contained a great deal of highly interesting work. In the collection were included several examples from Sir R. Wallace's fine collection of works of Décamps; a fair proportion of Turners, including the two little masterpieces, "Grouse Shooting" and "Woodcock Shooting," from the same owner; sundry Cotmans; Mr. J. P. Seddon's Rossetti, "Giotto painting the Portrait of Dante"; a good many of Mrs. Angell's exquisite bird pictures, &c. There was a considerable proportion of architectural work in the collection, some of it of remarkable character. We noticed especially some of De Witte's drawings, notably an interior at Haarlem, which is not indeed artistically effective, but which, as a clean, hard, precise, and realistic representation of architecture, is unsurpassable. Prout was well represented, and there was a fine row of great blotted (rather than painted) landscapes by David Cox at the upper end of the room.

UNDER the title "Echoes from Hellas" there is to be brought out, by Messrs. Marcus Ward & Co., the letter-press of the "Tale of Troy," as performed some little time since at Cromwell House, and that of the story of Orestes (from Æschylus), which is to be produced during the season at King's College. The text in both cases is by Professor Warr, and Mr. Walter Crane has undertaken to supervise and arrange the illustrations of the book as a whole, which will also include designs by Sir F. Leighton, Messrs. Poynter, G. F. Watts, F. Sandys, and Professor de la Motte. We have no doubt the volume will prove a very charming one; though we have an impression that Mr. Walter Crane's Greek may be a little too much tinged with Mediævalism for the occasion in hand.

STREET PAVING.

ONE of the weakest points in the growth and development of American cities is the condition of the streets and roadways, which are usually the last things to be thought of. Streets, both in the older towns and cities of the East, as well as in the newer communities of the Far West, are laid out and planned of magnificent distances and noble breadth; but while the buildings that spring up with such rapidity on either side are costly, and often palatial in character, nobody ever seems to think of the roadway between, which is frequently so neglected that it is not only an eyesore, but a serious danger to the health of the inhabitants. Of course, in the large cities, such as New York, Philadelphia, Boston, Chicago, &c., the thoroughfares through which the main traffic of the cities passes have more or less care taken of them, as are also those of the most artistic and expensive suburbs; but once we step aside from these, we find an unkempt and filthy roadway which would disgrace the very lowest mining village in Great Britain. The very first thing that strikes the traveller on his first visit to New York is the magnificence and solidity of the Broadway and the squalor and neglected condition of the streets that open out of it on each side. A drive (not by tram-car) from the dock to his hotel will set the new arrival in a state of acute alarm at the holes and the ruts over whch he is jolted, and he will probably have suffered more during the two or three miles ride than during all the three thousand miles by steamer from Liverpool; indeed, a short investigation will convince him that New York in this respect is a whited sepulchre, though, unfortunately, its bad example is copied by seven-tenths of the other towns in the States. One reason, perhaps, why the American town dwellers have come to regard the condition of things with equanimity is the fact that the tramway system is so enormously and universally developed that, as a rule, other public vehicles are in no demand, and when they are employed an unconscionable and prohibitory

tariff is asked. The consequence is that not one in a hundred thousand ever travels otherwise than by tram-car, which, indeed, has become a necessity from the extreme length of the journeys; and as the pitfalls on either side the rails are not felt by the inmates of the car they are supremely indifferent to the discomforts of those on foot.

It is not so much to be wondered at, in the case of a Far West city, like Omaha or Cheyenne, that the streets are looked upon as improvements that can wait, but the inhabitants seem to forget that the very breadth of the roadway may be a serious sanitary drawback, inasmuch as it offers harbourage for many inches of mud and sewage, the liquid portion of which naturally gravitates to stagnate at the sides. Crossings are only possible at long intervals, and then by a rickety plank-way, which, in wet weather, generally secures a ducking to the wayfarer. These remarks, which occurred to the writer after an acquaintance with a great number of American cities, will serve to introduce a more intimate knowledge of the Philadelphia paving, which has recently been the subject of a special report, containing some interesting and valuable information on street paving in general. Philadelphia has 1,060 miles of streetway, of which 573 consist of paved street, 447 macadamised, and 443 of unpaved. The former category possesses the following characters:—

Cobble.....	9,113,925 sq. yds.,	or 93	pr. cnt. of the whole
Granite blocks	654,148 ,,	6⅔	,, ,,
Asphalte.....	25,396 ,,	⅓	,, ,,
Total.....	9,793,469	100	

Practically, therefore, what is paved in Philadelphia is of cobble, which is laid upon a bed of loamy gravel without any sand, the size of the stones being very irregular and varying from 3 in. to 15 in. in size. The granite blocks do not appear to be laid very carefully, as they are not cemented, while the granite itself is of different qualities; and, as the system of repairs is that of letting out a district to the lowest bidder for a year's superintendence, the condition of the pavement generally leaves a good deal to be desired. Philadelphia specially needs good and enduring street pavements, because the streets themselves are unusually narrow (from 50 ft. to 60 ft.), leaving only 26 ft. and 34 ft. respectively for the roadway between the curbs, and even this space is so taken up by the tramway that the carriage-way on each side is reduced to 10 ft. or 12 ft. in width. Macadam is principally used in the suburban portions of the city, being usually 10 in. deep, and composed of blue gneiss rock.

It is scarcely to be wondered at, that, under the circumstances, the cobble pavement should be condemned in the report, as entirely unfit for use in so large a city. It is next to impossible to keep the stones in an even position, owing to their irregular shapes, while the numerous rifts and crannies afford access to immense quantities of street filth, which cannot be got away, and continually give forth injurious odours. The committee, therefore, recommends that no more cobble pavements should be ever laid down, but as it is impossible so to deal with the existing pavements as to be able to do away with them altogether, it also recommends that very stringent reforms be made, wherever repairs are wanted, as to the laying down of the materials. The main points are, that the stones should be broken of a uniform size, and none should be used less than 4 in. or more than 7 in. in size, while they should also be laid with the greatest dimension vertical. The red gravel upon which the stones are now placed contains about 16 per cent. of clay, and this, it is advised, should be used only as a sub-foundation, spread to the depth of 6 in., and well rammed or rolled. On it should be spread a layer of clean, sharp, river sand, not less than $\frac{1}{30}$ in. in size, and quite free from impurities; and when all this has been properly set, washed pebble should be raked over the surface to fill up the joints, and the whole rammed with a heavy rammer. The most important part of the inquiry is, of course, the best kind of pavement to be put down where none exists, or where the cobble can be superseded with advantage; and here the opinion of experts runs in favour of granite blocks and asphalte, either as sheet asphalte or as blocks. The wood pavement, although possessing many advantages, has been well considered, but rejected on the score of cost of maintenance and construction. The wood pavement of Paris has a first cost of 16s. per yard, while the contract price for repairs (to run for eighteen years) is 2s. (all but one halfpenny) per yard per annum, making the total expense during the eighteen years, 2*l*. 11s. 4d. per yard,—undoubtedly a much heavier undertaking than either granite or asphalte. It has been determined, therefore, to use the granite blocks where the distance between rail and curb (or curb and curb) is less than 20 ft., or, indeed, in any situation where the travel is heavy and continuous. It is to be used also in all streets, whatever the width, where the grade is steeper than 3 in 100. In open spaces, where the travel is slight, and the area wide, sheet asphalte is to be laid down, as also in streets where there are no tramways, and which mainly consist of dwelling-houses. Block asphalte is, however, cheaper, and more readily dealt with, though it has not such good wearing qualities as the other kind. The granite blocks should be laid upon a bed of strong, clean gravel, formed to the cross-section of the street; but if the travel is heavy, it is quite worth the expense of having a 6-in. foundation of concrete, which will make the pavement safe under all contingencies, and does not add to the cost more than 3s. 4d. per square yard. It is not every kind of granite that is suitable for pavement blocks, hard basaltic stone, that takes a polish under wear, being quite as objectionable as a softer quality, as well as gneiss and all rocks that are laminated in texture. The blocks must necessarily vary from 4½ in. to 8 in. in thickness, according to the estimate of travel, but, as a rule, narrow blocks give firmer footing to a horse and cause less noise; while, on the other hand, this must not be carried too far, on pain of injuring the strength of the block. Each block should be regular in shape, with rectangular edges and smooth faces, and they should invariably be laid with tar-cemented joints, so as to make the surface waterproof. Nothing is more destructive to a pavement than open joints, for access is given to all kinds of moisture and stable urine, which ferment, thereby loosening the joint, making the atmosphere of the street extremely unwholesome, and even penetrating into the drainage system of the houses. The expense of this most necessary precaution is very trifling, only 3½ gallons of tar being needed to every square yard at a cost of 1s. The general cost of laying down granite blocks tar-coated as above may be taken per square yard as follows:—

	6 in. deep.	7 in. deep.	8 in. deep.
Cost of blocks	7s. 2½d. ...	8s. 0d. ...	9s. 0d.
Cost of laying	3 2½ ...	3 5 ...	3 7
Total	10 5	11 5	12 7

Asphalte is of various kinds and preparations, but the most valuable may be soon summed up. That which is most in favour in Paris and other Continental cities is the asphalte *comprime*, made from an amorphous limestone, naturally impregnated with bitumen. This material has its habitat in the Vosges Mountains, as well as in Hanover and Sicily. Its after-treatment is simple, consisting of powdering, placing on a concrete foundation, and thoroughly compressing by ramming and rolling. The American asphalte mastic, with which the city of Washington is almost entirely paved, is an artificial compound, made of Trinidad bitumen, powdered stones, and sharp sand. Then there is the coal-tar concrete, which is much used, but is not really an asphalte at all, though improperly called so. It has a foundation of broken stone and coal tar, with a top surface of sand or fine pebbles and tar, made into a mastic, spread and rolled like the others. But this latter, though cheap and easily manipulated, has a serious drawback, and that is, its being a product of gas tar, obtained by intercepting the destructive distillation, when it has reached a certain point. The atmospheric influence to which it is exposed when laid down, causes gradual oxidation, so that the tar loses its cementing qualities, with the result of the sand losing its cohesion, and the pavement pretty quickly disintegrating. The American asphalte mastic can be laid down for 9s. per square yard; and as it is cheaper and less slippery than the *comprime* it is to be principally used in Philadelphia. All asphaltes require an absolutely rigid and unyielding foundation, the best being a concrete of hydraulic cement of at least 6 in. in thickness; and not only must the materials be essentially good and pure of their kind if the pavement is to have any wearing character, but the contract for maintenance should be carefully specified as to the amount of subsidence or dilapidation needing repair, for otherwise there is no class of work so open to scamping and dispute as this. Asphalte blocks are made of Trinidad asphalte and small particles of limestone moulded under heavy pressure. The best size is about 12 in. in length by 4 in. wide and 5 in. deep, and being uniform, the joints are extremely narrow and soon unite so as to make the pavement compact and waterproof. The cost, including a foundation of gravel and sand, is about 8s. 6d. per square yard.

The commissioners for reporting on the Philadelphia city re-paving, wind up with some excellent suggestions which are applicable to any town or city, no matter where it is. They are to the following effect. The crown or transverse section of the pavement should be the arc of a circle, with versine about $\frac{1}{50}$ of the chord, or, say, for

Streets, 26 ft. wide,	crown	4 in.
,, 34 ft.	,,	5 in.
,, 50 ft.	,,	7 in.
,, 70 ft.	,,	10 in.

In wider streets these may be slightly reduced, when the horizontal slope exceeds three $\frac{1}{100}$. The distance from the top of the curb to the surface of the pavement at the curb should be between 5 in. and 7 in., depending on the width of the street. Wherever the ground is soft and full of springs, "blind" or broken stone drains should be laid under the foundation, connected at their lower ends with drain-pipes leading into the nearest sewer. No sewer pipe intended to carry house drainage should be laid with open joint for the purpose of draining the soil, as in such a case the soil is sure to become polluted, and insanitary results follow.

The cost of this undoubtedly heavy undertaking of paving so extensive a city as Philadelphia, or rather as much of it as is to be re-paved, is thus estimated approximatively:—

1,000,000	sq. yds. of granite block at	14s.	7½d.	£730,000
6,000,000	,, ,,	10	5	3,120,000
1,100,000	,, sheet asphalte ,,	9	0	495,000
300,000	,, asphalte block ,,	8	5	126,000
8,400,000	,, Total.....			£4,471,000

From this has to be deducted 252,000*l*. for the value of 8,400,000 yards of cobble, leaving the net cost as 4,219,000*l*. It is also advised that an expenditure should be made each year of 400,000*l*. in laying fifty miles of improved pavement, at which rate all the old cobble streets would be entirely replaced in ten or eleven years.

LETTER FROM PARIS.

As our last letter predicted, the French Government will entrust to M. Alfred Darcel the direction of the Musée de Cluny. The successor of M. Du Sommerard, who was born at Rouen in 1818, has long enjoyed in artistic and more especially in archæological circles a reputation which seemed to point him out especially for a post which is also of a very special character. M. Darcel, among whose numerous works we may mention "Les Arts Industriels du Moyen Age et de la Renaissance," "Un Recueil des Faïence Italiennes," and "Excursions artistiques en Angleterre," has also distinguished himself by some articles of great erudition on the *mise-en-scène* of the theatre. His successor in the "Direction des Beaux Arts" is far from occupying any such important artistic position. M. Gerspach, who owes his administrative good fortune to M. Maurice Richard, the last Minister of Fine Arts under the Empire, has arrived rather late at his artistique apprenticeship, and the administration of our great national manufactures demands rather more obvious and definite capabilities.

The decision taken by the Municipal Council, on the other hand, in regard to the popular opera, has completely deceived our expectations. The question, as we before said, was that of arranging for first-class popular representations, at reduced prices, assisted by an annual subvention of 300,000 francs. In principle it was approved, but, at the last moment, the Council drew back. It was found, apparently, that "Spartan black bread" was better fitted for Parisian electors than the regal fare of the Athenian Republic; and the Opera, deprived of its subvention, continues to reserve for the children of fortune the *chefs d'œuvre* of its

repertoire. The decision is neither intelligent nor, in the true sense, democratic; but it is hoped that the Council,—which knows how to do generous things at times,—will better consult the interests of the Parisian populace in undertaking shortly the construction of a "Bourse de Commerce"; and, finally, in endeavouring to settle the question of cheap lodgings, a question which the continued crisis in trade renders a very grave one.

In regard to the former point, the recent vote of the Municipal Council will modify materially the aspect of one of the most crowded quarters of Paris, while it will render possible the necessary relief to the Halles Centrales.

It is in the Halle aux Blés,—that is to say, in the neighbourhood of the Bank of France, the Ministry of Finance, the Bourse, the Tribunal of Commerce, and the Town-hall,—that the long-demanded Bourse Commerciale will be installed. The Halle aux Blés is an immense rotunda, erected in 1769, on the ruins of the Hôtel des Soissons, the construction of which Catherine de Medicis had confided to Jacques Bullant. It is in the midst of a network of dark and narrow streets, and the construction of the future Bourse must be preceded by important street reforms, especially by the prolongation of the Rue du Louvre, between the Rue St. Honoré and the Rue Coquillière, and the widening of this latter as well as of the Rue Vauvilliers. The total cost is estimated at 29,000,000 francs, and the Administration hopes to complete the whole work in three years. This great project includes, let us note, three monumental fountains, with groups of allegorical figures in bronze or in stone. As to the "Logements à bon Marché," the first business is to create, on communal sites, four groups of model lodgings (*maisons-types*), the plans of which have been carefully studied by MM. Aldrophe, Lheureux, Vaudremer, and Bouvard, City Architects. If, to give an idea of these constructions, we take as a sample that of M. Bouvard, we shall see a building of five stories, of plain but agreeable and inviting aspect, the decoration carried out entirely in brickwork of various colours, the use of iron and brickwork permitting the reduction of the cost to about 167,000 francs, while favouring at the same time the application of the most recent improvements in regard to sanitary conditions. The building comprises a certain number of tenements composed each of two living-rooms with a kitchen and cellar (*cave*); all well lighted and ventilated. On this philanthropic experiment the Council proposes to expend, over the four blocks, 850,000 francs at the outset; and t is proposed, if the experiment succeeds, to carry it out generally in the most populous quarters of Paris. The Parisian artisan may thus find lodgings, provided with plenty of air, light, and good water, at rents averaging 250 francs to 300 francs.

We will not quit the subject of the administration without speaking of the creation of the two great extra-mural cemeteries and of a mortuary analogous to those in use in Belgium and Germany. The Municipal Council has devoted 5,400,000 francs to the establishment of these two cemeteries, which will be situated at Pantin and at Bagneux, and for which M. Formigé, the architect, has designed monumental façades of a severe and dignified character. As to the mortuary, the Council has for a long time been occupied with that question. In France the legal limit of time for interment is twenty-four hours; and even with the extension to forty-eight hours, in cases of sudden death, it is easy to understand how difficult and painful the situation often is for poor families in small dwellings. It is to remedy this state of things that the Administration has pressed on the Council, at all events as a trial, the erection, in the Rue Bolivar, of a special building, of which the plans have also been prepared by M. Formigé. This is a great rotunda, built in coursed stone-work, with a covered porch, intended for the reception of bodies till the moment of interment. Internally a series of mortuary-chambers, with glass partitions, radiate around a circular chamber, where a ventilating-shaft is established, which, by means of a strong furnace, keeps the air constantly pure in all parts of the building. 100,000 francs will be required for this building, the grave and sombre external architecture of which will be partially relieved by the verdure of a square formed around it.

In spite of the practical and humanitarian interest of this project, it is certainly pleasanter to turn to that of the grand charity ball which, as we have already mentioned, is to take place on the 11th of April at the Hôtel de Ville, and which will actually form the inauguration of the new municipal palace. Any one who can recall the receptions at the old Hôtel de Ville may figure to himself the splendours which are promised us. Immense staircases blazing with lights, and extending, amid a profusion of flowers and shrubs, between two hedges of Paris Guards in full uniform; a long succession of galleries and luxurious rooms, filled with splendid furniture, and of which the total extent is more than a kilomètre; two orchestras, directed by Arban and Olivier Métra, without counting the celebrated band of the Garde Municipal; add to this a world of statues, a forest of plants, all the riches of the hothouses of the municipality arranged by M. Alphand with his well-known and incomparable skill and taste, and you will have a rough notion of the fête of the Press, which will certainly be a marvellous spectacle and productive of solid receipts for the poor, while it will expedite the completion of the reception-rooms of the Hôtel de Ville.

These imminent splendours lead us to speak of those more remote ones which are promised for the Great Exhibition of 1889. The report which M. Antonin Proust is about to present to the Minister of Commerce sketches out the ensemble of the great work which is intended to commemorate the anniversary of the Revolution of 1789. We have already so far described * the scheme as to render it unnecessary to go into the details of this voluminous document, on which Parliament will soon have to pronounce, in voting a portion of the sum necessary to meet an expense estimated at 50 millions of francs.

The two chambers are also occupied with the subject of the Musée des Arts Décoratifs, which it is proposed to erect on the Quai d'Orsay, on the ruins of the Cour des Comptes. This project has given rise here to some strong and legitimate criticisms, for the Union des Arts Décoratifs is in danger of actually realising that proverbial form of simplicity which spends all its savings on a strong box to keep them in. People ignore, in fact, one result of that famous lottery of 14 millions (francs) which was so madly run after. Defalcations, losses, primary expenses, &c., have reduced the total to 5,800,000 francs; and instead of employing this sum to provide the foundation of a fine collection, here are people dreaming of building at great expense a kind of palace (which has not even the merit of being situated in an artisan quarter) before they have bethought themselves of providing wherewithal to fill it. This want of foresight is strongly blamed, and the art-industries are inquiring how the project of M. Proust is to benefit them, and why he has not followed the good examples set him by other countries.

Speaking of collections, we learn that the Louvre is to be enriched by a valuable gift, consisting of 550 bronze medals, executed by David d'Angers, and which the son of the celebrated artist has offered to the national collection, which is to exhibit them in the Salle Rude.

Last Wednesday (the 25th) the young architects intending to compete for the Grand Prix de Rome entered on their work. Of the four subjects proposed by M. Ginain (a "palais des arts décoratifs"), M. Questel (a "palais pour lourdes comptes"), M. Vaudremer (a "palais pour le parlement"), and M. Diet (an academy of medicine), the lot fell on the last-named subject. The time of competition extends over 110 days, and the final adjudication will take place on the 1st of August.

The remainder of our letter we must defer.

St. Mark's Sunday Schools, Manningham, Bradford.—The memorial-stone of the new St. Mark's Sunday Schools, which are being erected on a piece of land adjoining St. Mark's Church, Manningham, was laid on Saturday afternoon last by the Mayor, Alderman I. Smith. The building, which will be a plain, but substantial school-house, will cost about 1,400*l.*, including the furniture. The plans have been prepared by Messrs. Morley & Woodhouse. The land on which the school is being erected cost 1,000*l.*

* See the Paris letter of February 7th of this year.

SOME CELEBRATED TIMBER ROOFS.*

My subject to-night is celebrated timber roofs, and perhaps some one may be inclined to ask at the outset, Why not rather iron roofs, since the most conspicuous roofs of the present day,—such, for example, as our great railway station sheds,—are now carried by iron framing? Possibly it would be a sufficient answer to reply that this is Carpenters' Hall, and that I desired to select a topic which has to do with carpentry.

A good roof displays the skill of the carpenter better than any other piece of work, so that we should study the best things of the sort that have been done, even if only out of interest in carpentry. Another and a better reason is that, though the ironmaster is constructing our largest roofs now, he is not able to compete with the carpenter when it comes to roofs of moderate size; and as those of us here who are carpenters or builders, or who have to design buildings, will be sure to have to do with timber roofs for all ordinary work, it will be a help to know something about the best specimens that exist. A man never does full justice to himself unless he knows and can understand something a little beyond what he actually has in hand. So a single famous roof, thoroughly mastered, will be instructive even to those who have only very modest ones to frame.

Moreover, though ironwork has been found to have advantages which carpentry does not possess when the new requirements of trade and travelling have to be met, it must not be forgotten that in those numerous instances where the roof forms part of the architectural treatment of a fine interior, such as a church or public hall, timber from the very nature of things holds its own, and must do so. No ingenuity could fit buildings such as the Guildhall or Westminster Hall with iron roofs that would be consistent and beautiful, and where a roof is to be a work of art as well as of skill the carpenter must frame it.

Last, and by no means least, manufactured iron is not to be had everywhere. In the colonies, and in many foreign countries, if a large roof is wanted there is nothing but timber to make it of; and as, happily, England and her colonies are growing closer together as time goes on, we must be ready, any of us, in case we are wanted, to build or design in a manner suited to the circumstances of countries far removed from our own. I trust, therefore, that, for all these practical reasons, and not simply as an antiquarian or scientific study, we shall find it profitable to give attention to a few of the best known examples of timber roofs, ancient and modern.

[The lecturer here discussed and explained some of the elementary principles upon which carpenters base their practice in the matter of roof construction.]

Very large timber roofs on the queen-post principle have been framed. The limit to the span which may be usefully covered is the length of timber obtainable; for, though the tie-beams, which are only under tension, may be joined, the rafters must each be in one piece. A great difficulty arises, however, in practice, especially in the case of roofs of fir timber, which, though light, strong, and elastic, is apt to lose its elasticity in time, and take a permanent set. Fir timber, unfortunately, is also comparatively soft, so that the very great weight of the roof and its covering, with the addition of wind pressure, and snow, &c., is apt to squeeze the timbers together at the joints, and to cause a slight giving way, which throws the framing more or less out of shape, and destroys its efficiency.

Examples of roofs with tie-beams, and either king-posts or queen-posts, abound. Few of them can, however, be fairly called famous; partly, no doubt, because they mostly carry ceilings, and so their construction is seldom open to inspection.

I will, however, refer to one very bold timber queen-post roof, with a tie-beam and collar-beam, which is instructive because it has partly failed, and which can be seen without difficulty. I refer to the roof over part of the South-Eastern Railway's London Bridge Terminus. This roof was put up about the year 1850, and every principal is now supported by a prop. The span is 92 ft. The trusses are

* A lecture by Professor T. Roger Smith, delivered at Carpenters' Hall on Wednesday evening, April 1st, being the last of the present series of "Free Lectures to Artisans on Matters connected with Building," given under the auspices of the Carpenters' Company.

21 ft. apart from centre to centre. The principal rafter is 12 in. by 9 in., and the tie-beam 15 in. by 9 in.; in each truss there are five iron rods doing duty as queen-rods and intermediate rods, and the heads of the principal rafters and straining-piece are received into a cast-iron queen-head. The pitch, *i.e.*, the slope or angle with the horizon, is 21° only.

The failure of this roof may probably be traced to a series of causes rather than to any one prominent defect. The deficiencies of fir timber have been already pointed out, and here as elsewhere a close examination would no doubt show that the joints have compressed slightly, and that the timbers have bent. The distance apart of the principals is rather great, which throws a greater load on each truss than it ought to have. The pitch is too flat, which greatly increases the strain upon every part of the structure. The braces under the principal rafter are too few, and both the principal rafter and the collar beam are loaded not at the strong points, namely, those stiffened by the braces, but at points away from them, so as to be subjected to some cross strain. The scantlings are light, considering the work the timbers have to perform; and the large amount of flat space in the middle, and the small angle of the slope at the sides, would favour the lodgment of snow, so that a heavy fall of snow would throw a tremendous burden on to the framework of this roof in addition to what it has ordinarily to carry. Putting all these causes together, there is no reason to be surprised at the failure of this roof; and yet its appearance is striking, and gives the idea of its being both elegantly, skilfully, and boldly designed. Boldness has, however, been pushed too far.

It is believed that the widest timber roof in one span, with or without a tie-beam, ever executed is one that was erected over a riding-house at Moscow in the year 1790, of the enormous span of 235 ft. The principal rafters in the truss of this roof were replaced, or rather assisted, by a vast curved rib made of three thicknesses of timber indented together, and strapped and bolted. The design was ingenious, but after a time this roof partly sank, and I believe it is not now standing. The material is not stated, but it is not improbable that it was fir, and if so the use of that material may partly account for the failure of this great structure. Those roofs of considerable span which have been most successful have, in the majority of cases, been framed either in oak or in chestnut.

In the roofs with tie-beams which we have just been discussing, nothing more is attempted than to roof over a space requiring to be covered in, and, in most cases, to carry a ceiling. Sometimes also it has been desired to form a loft of some sort in the hollow space in the roof; and as the framing employed for these purposes has been designed to secure only those ends, it has been possible to use all the timbers in the situations where the very most could be made of them.

In making a roof, however, we enclose and cover in a large space above the top of our walls, and, in many cases, it is desirable to use this space,—not by constructing a loft in it, but by adding it on to the space below. This is simply enough done by putting such a roof as we have described on side walls, and leaving out the ceiling; but the tie-beams and framing very often have an appearance not in accordance with the architectural design of the building, and in many cases, as, for example, in the nave of a church, where the gable is occupied by a large window, the line of them will cut across and destroy the effect of an architectural feature. Accordingly roofs without tie-beams have been found requisite, and these form by far the most important and most interesting part of our subject. Roofs of this class were largely employed throughout the period which saw the rise and progress of Gothic architecture, as well as in modern times.

My friend Professor Kerr, in his opening lecture,* was necessarily restricted by his subject to tie-beam roofs, so that this class of structures was not touched upon by him; but I regret that when alluding to an unscientific form of roof occasionally to be met with in churches of small span, he did not do our forefathers the justice to add that innumerable specimens of their skill as roof-carpenters, accompanied by the greatest taste, have come down to us from the past. He may (unintentionally, I am sure) have left on the minds of some here the impression that the Gothic idea of a roof was only to throw a beam from wall to wall, to stand a post on the middle of it, and then to carry rafters from the top of the post to the wall. I am quite aware that this sort of roof is to be met with, yet I hope to succeed in showing you that in the centuries we call the Middle Ages carpentry was carried to great perfection; and I am the more anxious to do this because there is no country in Europe where carpenters were more skilful than in England, and because the acknowledged masterpiece of ancient carpentry is to be found in this metropolis, the work of English hands and the contrivance of English designers.

We have seen that where a timber is short it may be able to sustain a considerable amount of cross-strain, such as would break it were it long, and the earliest attempts at throwing the roof more into the body of the building than is possible with a tie-beam were made by putting the tie part of the way up the rafters, so that there was a short piece of rafter between it and the wall exposed to a strain which is partly transverse. A second step was taken when, in order to get rid of the straight line of the tie, two oblique timbers, each starting from the foot of one rafter and getting hold of the other some way up, were employed. Sometimes these two methods were combined, as in the timber roof over the vaulting of Westminster Abbey. In this manner, but with all kinds of variations, sundry very picturesque church roofs have been framed. Some of them carry polygonal ceilings, others show their timbers; but in either case the eye is carried upwards, and the space in the roof is virtually added to the building.

One remarkable example of this kind of roof is to be seen at the Hall of the Palace of Justice at Rouen, and those of you who have taken one of the opportunities now open of spending a short holiday in the very pleasant and instructive change of a trip to Paris, will, I have no doubt, have remained for a few hours in that interesting city on the road, and may have seen this Hall. The building of which it forms part is a fine Gothic structure of the end of the fifteenth century, the date being 1493. This hall is 150 ft. long and about 54 ft. wide, and is roofed, in a single span, by a roof without tie-beams. A timber ceiling, of an arched outline, conceals the framing of the roof, but a published engraving of the construction shows that there is a collar three-fifths of the height up the roof, and a second higher still, with a moderate amount of bracing to the upper part of the rafter, but nothing below the collar but oblique ties, and those very long ones. One authority says that the roof had tie-beams at one time, and that they have been cut away. However this may be, it keeps its form without them; there are no tie-beams or rods now, and the roof stands excellently well.

In many of these roofs there are no trusses or rafters stronger than the others, but every pair of rafters is tied in the same manner. It is also worth remark that the material employed in these roofs was, generally speaking, either oak or chestnut. Both these woods combine great strength with great hardness, and the latter quality prevents the danger of joints giving way, as they do in roofs framed of fir timber. Having, therefore, materials which permitted it, the designers of these roofs were quite right to use oblique ties or ties highly placed, and to subject part of their rafters to cross strain, because they could by these means attain objects not otherwise within reach, and could do so without sacrificing the stability of their structures.

A distinct class of roofs of large span, framed without tie-beams, next claims notice. I refer to *roofs with ribs*. Many of these are mostly of later date and wider span than the greater part of those already considered. The truss of Westminster Hall, it is true, displays, as we shall find, a large rib used for the structural purpose of steadying and stiffening the whole combination, and for the architectural purpose of adding to the framework a powerfully-marked line of an arched form; but such rib is only an auxiliary, as, for example, in the Moscow Riding School already mentioned. In some other examples a rib more or less similar to this forms the chief feature of the roof. The oldest specimens of the class, where the rib does the main part of the work known to me, are two Italian examples, of which Professor Lewis has kindly sent particulars. A great hall at Vicenza, known as the Basilica,—built in 1314, though since modernised,—no less than 70 ft. wide, is covered with a curved roof in the form of a pointed arch, in a single span from wall to wall, curved outside as well as in, and so resembling very much the hull of a ship turned upside down. The supports of this roof consist of ribs of timber about 12 in. by 12 in. Each rib is tied by two iron tie-rods, the first about one-third of the height up from the springing; the second about two-thirds up. A still larger hall of about the same date exists at Padua. It is 261 ft. long by about 85 ft. wide, and has a similar roof, of which the ribs are about 13 in. by 13 in., and about 6 ft. apart. They (like those at Vicenza) are secured by iron rods; but in this case the rods are introduced differently in alternate ribs, the first at the springing, and the second part of the way up, and so on.

Roofs with ribs did not, however, become common till a much later date. The next example that I have to quote is a roof which was erected over the Corn Market in Paris in the year 1662. This building is circular, and about 130 ft. in diameter. The present roof is a dome-shaped one on iron ribs, interesting as an early example of the application of iron to roofing, but the original timber roof, which was also dome-shaped, is the one with which we are at present concerned. It was destroyed by fire in 1802. A good account of its construction is given by Mr. Tarn in his excellent little treatise on roofs of wood and iron:—"The circular ribs consisted of planks 9 ft. long, 13 in. broad, and 3 in. thick; each rib consisted of three of these planks bolted together in such a manner that no two joints met. A rib was begun, for instance, with a plank 3 ft. long, standing between one of 6 ft. and another of 9 ft., and that was continued to the head. No machinery was needed for hoisting such small pieces, and the whole went up like a piece of brickwork. At various distances these ribs were connected horizontally by purlins and iron straps, which made so many hoops to the whole dome. Some of the ribs were discontinued part of the way up. Near the top those that were continued were framed into a circular ring of timber which formed a large eye in the middle, over which was an umbrella-shaped glass roof."

French architects and engineers in the sixteenth, seventeenth, and eighteenth centuries occupied themselves a good deal with roofs with curved ribs, and two systems of constructing the rib were worked out. In the most modern of them, that invented by Colonel Emy, the ribs were constructed of a series of thicknesses of bent timber, one on the back of another, and held together by bolts. In the older system, that of Philibert de l'Orme, the ribs were also built up, but the pieces composing them are placed side by side, and either form a polygon approaching a semicircle, or are cut to bring them to a curve. In fact, the ribs are very much such as have been already described as used for the great dome of the French Corn Market.

There is, however, a great difference between a dome,—the strongest of all forms, and one permitting the introduction of as many rings of ties as may be desired,—and a roof over an ordinary oblong space, where no such binding together is admissible, and where straight rafters may have to be used, which loads the rib at certain points only. In the latter case, a good many precautions have, generally speaking, to be taken to prevent the rib from being unequally loaded, and so either spreading or losing its shape in some other way. The rib made of unbent timbers, side by side, on De l'Orme's plan, is admitted to be stronger than the one made of bent timbers laid one on the back of the other; but both have been largely used, and good examples of both may be met with, even if we confine ourselves to English ones alone, and leave the French ones unnoticed.

A very fine roof with ribs, one on which the load (though light) is borne without a rafter solely by the rib, covers the great conservatory built by the Duke of Devonshire at Chatsworth. This building was rather notorious at the time of its erection, but has probably now passed out of the recollection of most people not familiar with Derbyshire. It consists of a wide and lofty central portion, with a kind of broad aisle at the sides, roofed at a lower level. The central roof here is of the section of a pointed arch and hipped at both ends, and is entirely covered with glass. It is carried by timber ribs, and the glazing is on the ridge-and-furrow principle. The low aisle referred to forms to some extent an abutment for the ribs, and the ridge-

* See *Builder*, p. 264, *ante*.

and-furrow glazing helps no doubt to fortify them, but still the greater part of the strength is derived from the ribs themselves. I had recently an opportunity of examining this building carefully, and though it does not appear to have been as well taken care of as one could wish, still the roof remains sound, and the ribs appear true to their curve and in line with one another.

Another rib roof, and one which obtained a world-wide celebrity, was the roof over the nave of the Great Exhibition of 1851, reproduced in its main features in that of the nave and transepts of the Crystal Palace at Sydenham. Here, again, the load is a continuous one, the roof covering being the same shape as the rib.

It was intended that the '51 Exhibition should have a flat roof over the nave, carried by long lattice girders, and it is understood that the merit of suggesting a semicircular roof instead belongs to Sir Charles Barry. The construction was, no doubt, designed by Sir Charles Fox, who made the working drawings of the entire building with his own hands. The span of this roof was 72 ft.; the principals were 24 ft. apart from centre to centre; they consisted of timber ribs measuring 17½ in. deep and 11 in. wide at the back, and 8 in. in width in the main part of the rib, and formed of no fewer than eleven pieces of timber bolted together. This construction combined the two systems of rib-building described. These ribs appear to have stood well, as have the ribs of the Crystal Palace roof.

For the Exhibition of 1862 at South Kensington a somewhat more solid building was designed by Capt. Fowke. It had a nave with a semicircular rib, but had also a rafter, so that the covering did not follow the outline of the rib. The span was greater than at the Crystal Palace, being 85 ft. against 72 ft.; the depth of the rib was ½ in. more, being increased to 18 in., and the width of it was 10 in. It was made of six pieces only, and was entirely on the older or De L'Orme's construction. The distance apart was increased to 25 ft. This roof was, I believe, re-erected at the Alexandra Palace, and was destroyed in the great fire at that building. In the '62 Exhibition many annexes were built, with ribs having a span of 50 ft., and a distance apart of 15 ft. The ribs were 3 in. by 9 in., and these roofs failed seriously by spreading.

In the great buildings occupying the same site, and covering many acres of ground, which were erected for the Fisheries Exhibition and added to for the Health Exhibition, many acres of roofing were put up by the late General Scott, of which the wider spans recalled to some extent the annexes already alluded to. These are, however, a little stronger in various respects, and they appear to have answered the expectations of those who designed them. The span of these roofs is a little less, and the principals are considerably nearer together, than in the roofs which failed in 1862. The span is 48 ft. The polygonal rib (which is virtually semicircular) springs 10 ft. from the floor. The sides of the building continue to a height of 27 ft. 6 in. from the floor, or 28 ft. from the ground, and the ridge is 40 ft. from the ground. This rib is 2⅜ in. thick by about 10 in. average depth, and is in three thicknesses, made up of deals,—a middle 1¼ in. thick by 9 in., and two ⅝ in. by 9 in. at the sides. The pieces of which the rib is composed are 6 ft. long. At every 6 ft. there occurs a radiating brace, 9 in. by 1⅜ in., pointing to the centre of the arch. Each brace is worked into the substance of the rib, and seems to connect it to the uprights of the side framing or the rafters, as the case may be. The ribs are 10 ft. apart, and the boarding is carried by small rafters, 6 in. by 2 in., laid purlinwise on the back of the principal rafter belonging to the truss. This is probably as slight a construction as has ever been successfully employed.

This series of roofs may be closed by a reference to a roof with timber ribs on Colonel Emy's plan that has failed. I refer to the roof put up at the terminus of the Great Northern Railway, King's-cross, in 1852. This was a roof where a semicircular rib was combined with rafters, and the covering did not follow the outline of the rib. The spans were each 105 ft., the ribs were 20 ft. apart, and each rib is stated to have consisted partly of eight and partly of sixteen 1½ in. bent boards, screwed and bolted together. The trusses soon after being fixed showed signs of spreading, and were buttressed at the feet. The ribs became distorted in shape, being perceptibly flattened at the top, and after remaining in that condition for a good while (probably about twenty years) the ribs of one of the two spans have been replaced by trusses with a wrought-iron semi-circular rib. This experience seems to tell decisively against the use of ribs made on Colonel Emy's plan of bent timber, for they were employed here under conditions on the whole very favourable.

The roofs with oblique ties, like Westminster Abbey or the Rouen Hall, and those with curved ribs, like the Crystal Palace or the Health Exhibition, by no means exhaust the list of roofs without tie-beams. Another method of dealing with the same problem was worked out towards the close of the period which we call the Middle Ages, and, as it resulted in the most splendid and most thoroughly architectural roofs that we have to consider, I have left it to the last.

The earlier stages of the growth I am about to describe may be illustrated from church roofs; the concluding and most complete was employed chiefly for the roofs of halls much wider than the nave of an ordinary church, and it is from such halls that we shall get our best examples. Let us go back to church roofs as they were executed at the middle of the fourteenth century.

The walls in common use were very thick, and, as the gutter was usually an eaves gutter, it became customary to carry the rafters to the exterior, and to frame them into a short horizontal timber, which lay across the wall, and from that timber to carry up a little post or prop flush with the inner face of the wall, to support the rafter near its foot (see fig. 1). The idea suggests itself that by prolonging this short horizontal timber, usually called the wall-piece, the prop assisting the principal rafter might reach it more nearly at the point where its aid was needed (see fig. 2.) It will be seen at a glance that the wall-piece here acts as a lever, of which the inner edge of the wall is the fulcrum. The weight of the rafter presses on the long arm, and the short one is accordingly extremely strong, and affords nearly as good a support for the upright post as though it rested on the wall itself. By degrees this wall-piece was pushed out more boldly, and it soon was felt that a strut, S, from the wall below (see fig. 3) would give some additional strength, and would also satisfy the eye by preventing the rather unsightly overhanging horizontal piece from appearing to have nothing to carry it. So the strut was introduced, and in church roofs it became usual to curve or mould it, so as to make it a better architectural feature. The next step was to carry up from this same point a second strut, A (see fig. 4), to a point further up the rafter, and afterwards a tie was sometimes added at B to give a hold on the collar-beam or tie-beam, whichever we call it, above. In roofs having any pretension to artistic treatment the inner faces of these struts and ties were cut to curves (see fig. 5).

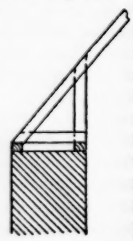


Fig 1

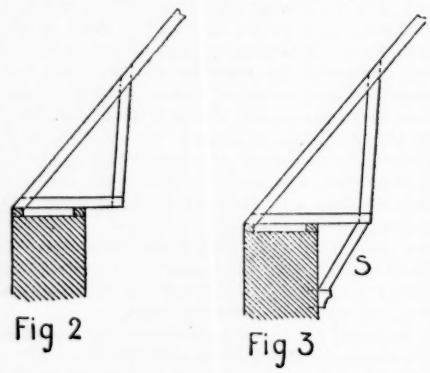


Fig 2 Fig 3

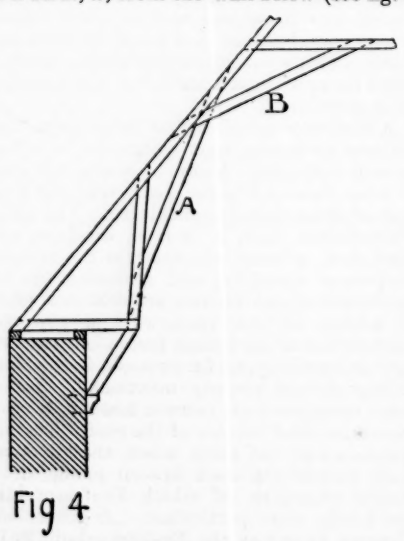


Fig 4

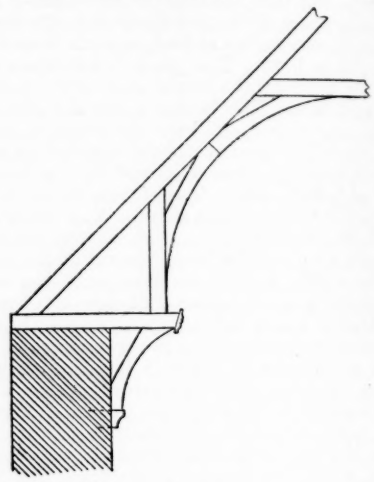


Fig 5

This combination of struts, horizontal piece, and posts is to be met with in many great roofs which were successfully framed in England, and a system somewhat similar, though not identical, was pursued in France. In the English examples the elongated wall piece is called a hammer-beam. The horizontal tie or collar-beam is generally about half way up the rafter, and the lower half of the rafter is fortified by support derived from the hammer-beam, through the post and strut rising from it; the hammer-beam itself being in turn supported by a strut from a corbel built into the wall.

The finest and almost the earliest example of a hammer-beam roof, and, no doubt, the finest timber roof in the world, is the roof over Westminster Hall, which I will now proceed to describe.*

Westminster Hall is 68 ft. wide between the walls, and 238 ft. long. It is 42 ft. high to the top of the walls, and 90 ft. to the ridge of the roof. It is divided into twelve bays, which will accordingly average 19 ft. 10 in. each. Consequently each truss has to span 68 ft., and to carry, in addition to its own weight, the weight of slates, timber, &c., necessary to roof in 1,359 ft. of floor. The pitch or angle which the slope of the roof makes with the horizon is 52°. The material employed was at one time believed to be chestnut, but is really English oak. The appearance of the two woods is so much alike that some uncertainty may well be pardoned. The date of the roof is A.D. 1397, so that if it escape accidents, in twelve years more it will have been standing 500 years. The timber is in good preservation and of large scantling; that is to say, large sectional area. The workmanship throughout is of great beauty and accuracy, and no extensive repair, so far as I can find out, has ever been found necessary.

The principal rafter of each truss is of considerable strength. The collar is placed just half way up the rafter. The hammer-beams receive the foot of the rafter at their extremity, and each projects rather more than a quarter of the span from the wall, and has its end beautifully carved with the figure of an angel carrying a crown. A strong post is carried up from the end of the hammer-beam to the point where the collar and the principal rafters join. A timber, which may be called a wall-post, rises from a corbel far down the wall, and supports the underside of the hammer-beam at the point where it leaves the wall, and a second post vertically above this supports the principal rafter. There is a strong and richly-moulded rib, which acts as a bracket or strut, springing from the corbel just referred to, and

* See large photolithographic illustration which we publish this week, from a drawing by Mr. F. T. Dollman.

framed into the hammer-beam near its free end. A second similar rib, rising from the hammer-beam, supports the middle of the collar. All these pieces, except the principal rafters, are knit together by a magnificent arched rib springing from the corbel from which the lowest carved rib starts, and framed to the hammer-beam, the post on the back of that beam, the collar, and both the curved ribs. Above the collar a second collar is introduced, and a post connecting the two is added, while at the middle of the truss a central post, something like a short king-post, occurs. Between all these timbers there is a kind of filling in of mullions or small posts, the spaces between having ornaments at the heads. These, no doubt, perform quite as much the important structural duty of connecting every member of this great framework together as they do the artistic duty of filling up the great outline with subordinate features which give scale to it, enable its vastness to be appreciated, and bring out the variety of its lines by their contrast with the uniformity of the filling in.

The usual longitudinal timbers, called purlins, running from truss to truss, are employed here, and furnish support to the roof rafters. The purlins are themselves supported lengthways from the great trusses by braces. The middle purlin is supported by a beautiful arched rib springing from the post on the hammer-beam. The upper purlin has a curved brace springing from the principal rafter. The lower purlin has a curved brace springing from the back of the great curved rib. Below this purlin occur the openings in the roof covering, which correspond with the great dormer windows, from which the hall receives a considerable portion of its light, but which are said not to have been part of the original design.

I have already mentioned the fineness of the workmanship: I need only add that every ornamental part is equally well wrought, and is designed with the greatest skill, so that whether we scrutinise a small portion or endeavour to take in the impression to be produced by the whole, we are equally convinced that this is a masterpiece of architectural art as well as of the carpenter's skill.

For about 200 years,—that is to say, during the fifteenth and sixteenth centuries,—hammer-beam roofs were in use, and as many considerable halls were built during those two centuries, numerous examples remain, none of them equalling Westminster Hall, though many of them approaching it in beauty, if not in extent. A few of these I will name to you.

The roof of the hall of Eltham Palace, dating, I believe, early in the fifteenth century, was a fine one. The hall was 101 ft. long by 36 ft. 3 in. wide, and 54 ft. high, and had a hammer-beam roof very much like that at Westminster in design, but without the great rib, and rather less steep. This roof was of oak, and remarkable for the beauty of the workmanship and goodness of the material. This building has been allowed to fall into decay. Fifty-nine years ago Mr. Dunnage found that water had soaked the wall-plates, and they had decayed, and given way, occasioning the failure of the roof. Part of it is, however, still standing, but soon the whole will have disappeared.

At Oxford, timber roofs of various degrees of beauty, but all belonging to this class of construction, occur in the halls of at least half a dozen colleges, namely, Corpus, University, Wadham, Jesus, Oriel, and Christ's Colleges; and in Cambridge in two or three such halls, as St. John's and Jesus Colleges. There is a plain roof of this sort at Westminster School, one more ornamented at Gray's Inn Hall, and another at the Library at Lambeth Palace, an apartment of much dignity and beauty, 93 ft. long, 38 ft. wide, and 50 ft. high.

Perhaps, however, the finest specimens after Westminster, certainly among the most ornate, are two that date from the sixteenth century, —the roof of Wolsey's Hall at Hampton Court Palace, completed about the year 1526, and that of the Middle Temple Hall, London, erected in 1572.

The hall at Hampton Court is 106 ft. long by 40 ft. wide, and 45 ft. high to the top of the walls, and 60 ft. high to the ridge. The framework is extremely florid, heavily timbered, and extremely rich in its mouldings and carving. There are some finely-carved pendants, and arched corbels running lengthways of the building as well as across it, serving to add to the richness of its appearance as well as to its strength. The ribs or brackets which support the end of the hammer-beam spring from corbels unusually far down below the top of the walls, so as to increase the strength of the truss. A peculiarity of this roof is that it is not open right up to the rafters through its entire height, but a wooden ceiling of curved outline is carried so as to cut off portions of the upper part. The outline of this roof is also peculiar externally.

The roof of Middle Temple Hall displays a peculiarity which is rare in hammer-beam roofs of large span, though not infrequent in the timber roofs of moderate span to be found in the churches of Suffolk and Norfolk. I allude to a double hammer-beam. Suppose the collar-beam of one of these roofs to be cut, the middle of it to be taken away, and each of its ends to be treated just like a hammer-beam, that is to say, supported by a curved rib and made to carry a second post, which is carried up to meet the principal rafter high up, and above which there may, perhaps, occur a short collar-beam, we now arrive at a piece of framing to be found frequently in the churches in such towns as Ipswich. This outline forms the basis of the fine roof of the Middle Temple Hall. In addition to its double hammer-beams this roof has a series of very conspicuous curved ribs, placed lengthways of the Hall, carrying the purlins and springing from the posts of the truss near the point whence the curved ribs of the truss itself rise. The foot of the posts is formed with rich bosses, from which the ribs spring, and the whole produces a singularly rich and well-combined effect, which harmonises well with the panelled woodwork that lines the walls, and with a rich screen at the lower end of the Hall.

There is an interesting record in connexion with this Hall,—Shakspeare's play "Twelfth Night" was performed here in the year 1601; that is to say, during his lifetime, and during the time that his theatre, the Globe Theatre at Bankside, was standing and in use. In all probability, therefore, the play was represented by his company, under his direction, and it is even possible that he may have taken part in it.

One other observation not strictly belonging to carpentry arises out of the comparison of the earliest and the latest of the great hammer-beam roofs that have come under our notice, Westminster, dating from 1397 and the Middle Temple from 1572, the first in the reign of Richard II. and the second in that of Elizabeth. In the interval a great revolution of taste as well as in literature and religion had taken place. Modern Europe, as distinguished from the Europe of the Middle Ages, began in the sixteenth century, and the reformation of religion, the revival of Greek and Roman learning, the birth of the modern literature and fine art, and the return to Classical architecture, are all parts of the great change which took place at this time. The reign of Elizabeth is marked by an architecture of change. You all must have heard something about Elizabethan buildings. Their great interest lies in the fact that in them we can see the old Gothic architecture disappearing and the revived Classic advancing. The two are, indeed, blended in a manner which is at times most picturesque. The Middle Temple Hall is an example, and a very good one, of this style. The roof is still in its main lines allied to the Gothic roofs which went before it, but its ornaments and its mouldings are both of them different, and follow Italian models. Just the same thing may be traced in the roof of Lambeth Palace Library, and it is worth notice,—if for nothing else,—as an example of how the architecture of old buildings properly understood preserves to us visible and tangible records of the political and social history of our country. Such buildings continue to illustrate the past for centuries after the men who erected them, with their manners and customs, have passed away from the face of the earth.

I propose, in conclusion, to mention a few important modern English roofs belonging to recent buildings of Gothic design. I shall first refer to a tie-beam roof of fir, but one in which the general principles adhered to by the carpenters of the Middle Ages are followed,—I mean the roof on the great hall of the Law Courts. This roof is not what is commonly called an open roof,—that is to say, not a visible roof like that of Westminster Hall, as it covers a vault of masonry which forms the ceiling to the hall.

The span of this roof is considerable. The pitch, as will be apparent to any one who notices the gable of the Hall in passing up the Strand, is comparatively steep, and would have permitted the use of tiles. The truss is a king-post truss, but the principal rafters are each of them double, that is to say, the two usual principal rafters are framed, in the usual manner, into the beam and king-post, but, in addition, immediately within them, a kind of inner and additional principal rafter is employed. This method adds a good deal to the strength of the roof, and was not unfrequently resorted to by Mediæval carpenters.

Another peculiarity, which was my chief inducement to include the roof over the Law Courts, is the employment of a *flèche* or timber spire to ornament the building. This spire is carried on the ridge of the main roof. These timber spires are among the most difficult and intricate pieces of carpentry known, and, owing to the great height at which they commonly start, few persons recognise their great size and consequent weight. Nor is the weight of a roof spire the only, or even the most serious, strain that has to be provided for. Such a feature rises in the unsheltered region where the full force of every hurricane that blows is felt, with nothing to break the shock; and although such a spire is usually circular or octagonal, so that the wind has less purchase against it than if it were square, we must not forget that it is very tall, so that such pressure as is sustained is intensified at the foot of the structure where the roof has to support it. And this weight and wind-pressure has to be supported, not on any solid basis like the masonry of a church tower, but on the framework of a roof spanning a vacant space. A famous example of such a structure is the *flèche* at Amiens Cathedral, which was measured and drawn by the late William Burges, and was shown, by the courtesy of the Architectural Museum, in our recent Exhibition. Another well-known example is the timber spire in the Cathedral of Notre Dame, in Paris, reconstructed by M. Viollet-le-Duc, and fully described and illustrated in his "Dictionary of Architecture." Another, but smaller, example surmounts the roof of the Guildhall.

The details of the construction are hardly fit for a lecture like this, and can be best unravelled by a patient study on the spot; but the general principles involved may be said to be, first, the distribution of the weight over as wide a space as possible. This is effected by carrying part of the load on to trusses right and left of the one immediately under the spire itself, by the help of sundry oblique bearers, as strongly framed as possible; and secondly, the *stiffness* of the actual spire. This is sought to be obtained by a central post running from base to top, a large number of sloping rafters, with many diagonal braces, introduced in every possible way, and a large series of horizontal ties or purlins at various heights; thirdly, by as strong a connexion as possible between the spire and the base established on the trusses of the roof. A great many timbers are employed, put in various positions, so as to stay every point as much as possible, and the result seems to be that this lofty structure is perfectly secure.

The roof of Lincoln's Inn Hall, part of the new buildings erected by Mr. Hardwick in 1845, is a fine hammer-beam open roof. The hall is 120 ft. long by 45 ft. wide, and 64 ft. high. The roof is framed of oak. Unfortunately I am not able to produce an illustration of it.

The great hall of the Manchester Assize Courts, a building erected from the designs of Mr. Waterhouse, has a fine open roof, of a construction which presents a somewhat unusual combination. The hall is 100 ft. long, 48 ft. 6 in. wide, and 75 ft. high; it has seven timber hammer-beam trusses dividing the length into eight bays of the somewhat unusual extent of 25 ft. each. The hammer-beam trusses do not, however, carry the whole weight of the superstructure, as is the case with every other roof with which we have dealt; two trussed purlins, or, more properly, latticed timber trusses, 16 ft. 6 in. deep, run, in lieu of two of the purlins, from end to end of the hall and bear on the gable walls. These are, of course, framed to each hammer-beam truss, but, being of themselves of considerable strength, they do a large part of the work; and, indeed, I gather from the architect's own published account of this roof that, in his opinion, the chief duty is thrown upon them. They, he says, support the upper part of the roof, while the wall-brackets, which form the lower part of each

hammer-beam truss, are needed chiefly to steady them. The architectural effect of this roof is excellent, and I dare say some of those present have seen it.

The last modern timber roof which I shall refer to is the roof over the Guildhall, London, erected a few years ago from the designs of the City Architect, Mr. Horace Jones, whose fine roof over the new Council Chamber, in which, however, the main framework is iron carrying a timber ceiling, is also illustrated by some of the drawings on the walls. Guildhall is 159 ft. long. Its width is not perfectly uniform, but the average is 49 ft. 6 in.; it is 80 ft. high. The roof is constructed, as every roof which is to form part of a public building of the first importance should be, of oak. Practical carpenters will be the first to appreciate the increased strength and solidity and the greater tenacity of the joints, and the freedom from the risk of their crushing in, which the use of oak secures, as compared with deal, or even pitch pine.

In the Guildhall roof there are seven principals, and therefore eight bays of about 19 ft. each. The collar of this roof is 29 ft. long, and it was cut out of timber about 2 ft. 8 in. square. In this roof each principal springs from a cluster of strong shafts carried up within the walls for the purpose of receiving it. Both structurally and as a means of procuring architectural effect this is very advantageous. There might have been some risk in putting the heavy weight of this roof on parts of the very ancient walls of this venerable hall which had not been so weighted before, and these lines of support divide up the length of the hall, and so make its extent perceptible. They also carry up the apparent (and, in fact, the real) support of each principal from the solid floor, and so aid the architectural treatment in more ways than one. The curved ribs are made very prominent in this truss, and the hammer-beam is kept rather modest than otherwise; it is neither carved at the end, nor marked out by a pendant, so that the line which catches the eye is that of the cusped arch of the moulded rib. This is an original treatment, but the success of the roof fully justifies the architect in the course which he adopted.

With these modern examples we leave our subject. I trust that the accounts of great roofs which I have been able to give you, and the illustrations which, in addition to diagrams made specially for to-night, I have been enabled to show you, by the courtesy of the City Architect, Mr. Waterhouse, Mr. St. Aubyn, and others, have been sufficient to prove that a great timber roof requires no small amount of skill to be brought to bear upon its design. I hope we have also seen that it, above most things, calls for very careful selection of good material, and, perhaps, most of all for honest, painstaking care in the workmanship of every part. No single joint should be defective, and every part should bear truly on those into which it is framed. I think, also, we have seen abundant cause for ranking timber roofs as among the important architectural features of a large class of ancient buildings, and especially let me add, of ancient English buildings; but I cannot, lastly, help adding that I think we have seen reason also to be proud of our modern works in this line, as well as of the ancient ones. Neither in the architectural design of these structures, nor in the mechanical skill with which they are framed, need the architects and the carpenters of the nineteenth century fear a comparison with their forefathers of the fifteenth and sixteenth.

ON DRY ROT IN WOOD.

IN the Public Health Section of the late meeting of German Naturalists and Physicians at Magdeburg, Dr. Poleck, professor at the University of Prague, read an interesting paper on the life history of the fungus known in this country as "dry rot," and by botanists as *Merulius lacrymans*, the ravages of which have of late years assumed alarming proportions wherever the building of new houses has been extensively carried on, but in Germany especially have become a question of almost national importance. For its prevention a knowledge of its life-history and habits is absolutely necessary, and these researches may also serve to explain the curious fact that, while it rarely attacks the timbers of the oldest buildings, it has seriously endangered the stability of many erected within the last few years.

Its original *habitat* is not known, for it does not attack living trees, nor is it ever seen in decaying wood in forests. It is found, so far as we are aware, only in the timber of houses, chiefly, if not exclusively, in deal and pine. The name "dry rot" is not quite appropriate, for a certain dampness and darkness are necessary for the development of the spores. These give origin to a mycelium of elongated cells, which spreads with surprising rapidity, covering the surface of the timbers and walls with fan-shaped expansions, and, penetrating the cylindrical fibres and cells of the wood, break it down by a chemical action into a light brittle mass. Complete desiccation of the mycelium permanently destroys its vitality. Though at first developing only in the dark, it seeks the light for the purpose of sporiferation. The sporangia, which have a reticular structure, vary in size from that of a lentil to that of a shilling, and exhibit a somewhat concentric arrangement of cushiony folds, at first of a wine red, and lastly of a dirty brown colour, when they exude drops of a clear fluid, whence the specific name of *lacrymans*. After emitting vast numbers of cinnamon brown spores, not more than ·01 mm. in diameter, the sporangia become black, dry up, and die.

In the art schools attached to the Breslau Museum the mycelium has spread from the foundations to the wall plates, and the casts and models are covered with the dustlike spores. Some of the threads have been found to measure as much as 5 or 6 yards in length. Dr. Poleck has not succeeded in cultivating it artificially, but another investigator, who has not yet published the result of his experiments, is said to have been more fortunate.

The chemical composition of the *merulius* does not differ much from that of similar fungi. The water varies from 50 to 70 per cent., while of the dry substances 5 per cent. is nitrogen and 15 fat. There are, besides acids, a bitter substance, and indications of an alkaloid. The mineral constituents, among which potassium and phosphoric acid are the most important, throw more light on the action of the fungus on the wood, which, as we have said, is not properly decay, but a chemical disintegration in consequence of the abstraction of these elements of its composition. As these are exhausted, the mycelium spreads outwards, much in the same way as the so-called "fairy-rings" are formed.

A clue is thus afforded to the increased prevalence of dry-rot of late years. It is well known that to facilitate the removal of the bark the practice of felling timber during the spring and early summer has become very general, and analysis has shown that the wood of coniferous trees at that season, besides being more watery and difficult to dry, contains five times as much potash and eight times as much phosphoric acid as in winter, conditions highly favourable to the development of the fungus.

If the use of such wood cannot be avoided it should be thoroughly seasoned and dried, if need be, by artificial heat. The use of old building materials should be shunned, and infected or suspected wood be burned. In the absence of experiments on the artificial cultivation of the *merulius* we are without any exact knowledge of the relative value of the several reputed preservatives, but since dampness is an essential condition of its growth, the importance of maintaining the utmost possible dryness of foundations, joists, and floorings by means of concrete or asphalte, *efficient* damp-proof courses, and thorough ventilation, is obvious. It is scarcely necessary to observe that the treatment of woodwork with arsenical or mercurial solutions is fraught with the gravest dangers to health, however successful in their immediate object. If chemical preservatives must be used they should be restricted to one or another of the products of the distillation of tar, though in this, as in other things, prevention is better than cure.

Proposed New Theatre for Exeter.—An Exeter paper states that a company will be forthwith formed to purchase a site in Longbrook-street, and erect thereon a theatre with every modern appliance. Mr. C. J. Phipps, F.S.A., was in Exeter last week, and surveyed the site, which he considers admirably suited for the purpose, as it affords ample space for double exits from the stage and every part of the house.

Illustrations.

NEW WAR AND ADMIRALTY OFFICES: REVISED DESIGN.

WE publish this week the designs by Messrs. Leeming & Leeming for the proposed War and Admiralty Offices, as modified, we presume, according to the suggestions or wishes of the Office of Works; though the modification does not seem so great as we were led to suppose was taking place. The most important change is the shifting of the tower from the angle next the Horse Guards to the re-entering angle of the St. James's Park front. This is an improvement as far as the junction of the building with the Horse Guards is concerned, though the position of the tower in itself is certainly not effective, nor does it mean anything in relation to the general design. The exaggerated projections of columns and stylobates, carrying nothing but small statues, appear to remain *in statu quo*,—on the Park front, at all events; and the Whitehall front still shows its curious anomaly (or what ought to be an anomaly) of two symmetrical pavilion features, one of which leads into the main courtyard and marks the main entrance, and the other marks nothing in particular; the front having, in fact, little relation to what is behind it. This has been so often the case in Classical buildings for official purposes on a large scale, that perhaps one ought not to be too critical over it, only one desires to see some improvement in these æsthetics of architecture, not a repetition of old faults which have the respectability of precedent.

The plan is in many respects a good one, and the objection to the enclosed quadrangle has been partially met by widening the quadrangle in the revised plan (which is not yet available for publication). Other improvements have been made, especially in the position and arrangement of the lavatory accommodation, some of which was very badly placed in the original plans, leaving little possibility of proper ventilation for the closets. The Whitehall front has been set back 30 ft. (except the two end blocks), with manifest improvement, and the entrance widened.

We are indebted to Messrs. Leeming for the permission given, pursuant to that of the Office of Works, to publish the altered design, and should be glad if we could express ourselves more in sympathy with it in regard to its architectural character. Considering the greatness of the occasion, we cannot honestly do so, or say that we regard it as a design equal to the situation. But any shortcomings in the design itself are as nothing compared with the tremendous architectural blunder made in the choice of the site, which we protested against from the very first; that, namely, of leaving the two Banks and the smaller buildings between them facing Charing-cross, and carrying a wing of the new building round in their rear. The perspective drawing of the Whitehall front here given seems as if made on purpose to show and to emphasise this mistake. Let those who will be called upon in a few days to vote upon the subject just look at that view,—at the mean and piecemeal effect of the new building half hidden behind the inferior buildings on its front; and let those who have any architectural sense and any national pride (and we have generally found the two qualities go together a good deal) say if that is a worthy way for a great and wealthy nation to carry out a building of the first importance for the palace of its military and naval administration. This defect is no fault of the architects, who had the site given them; but it is no less an utterly deplorable one, sufficiently so to justify a reconsideration of the whole arrangement of the site before any money is voted.

THE ROOF OF WESTMINSTER HALL.

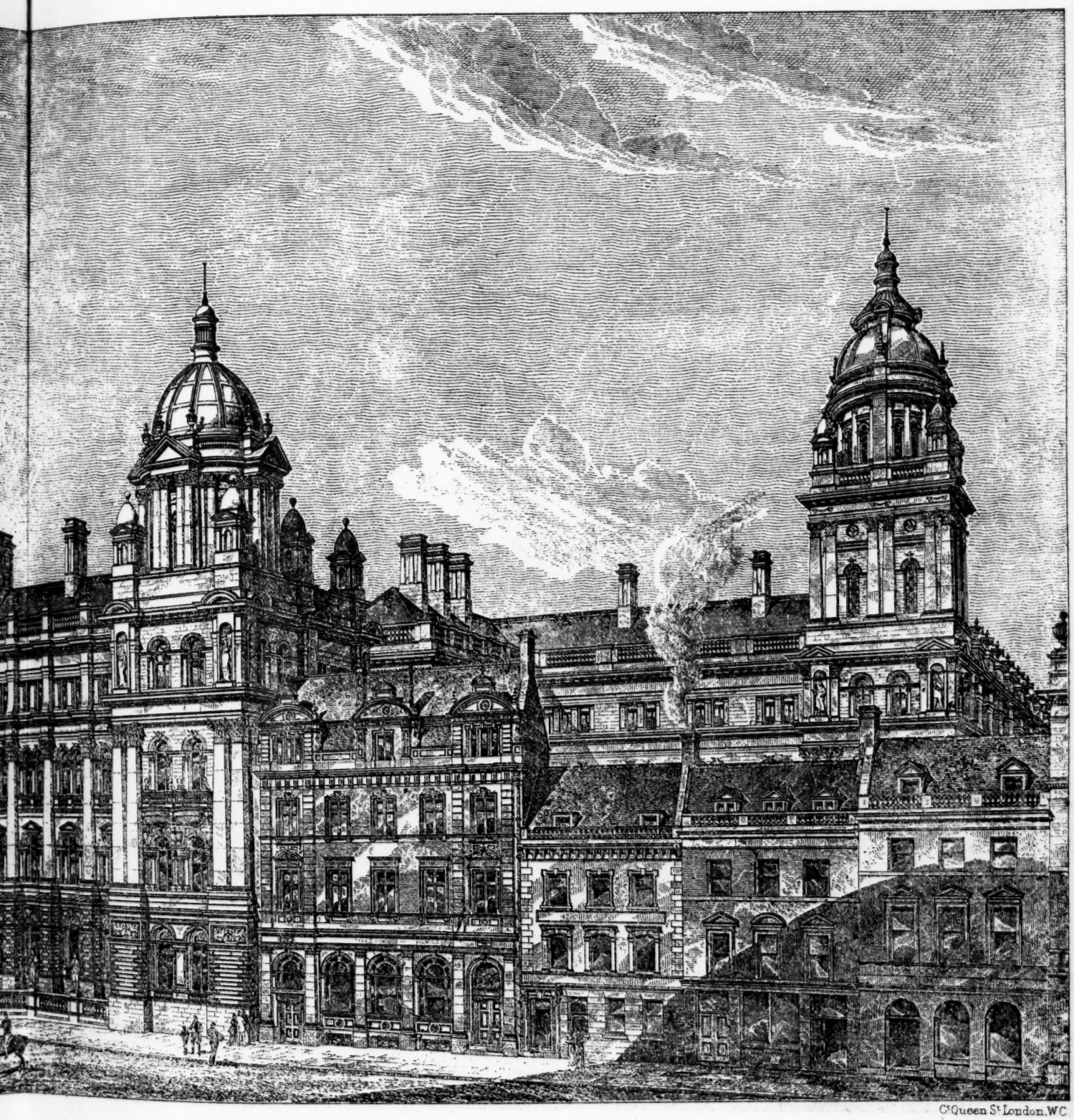
IN illustration of Professor Roger Smith's lecture at Carpenters' Hall on "Celebrated Timber Roofs," we are enabled to reproduce a drawing by Mr. F. T. Dollman of that splendid specimen of the hammer-beam type of roof which spans Westminster Hall, and of which special mention and description are made in the lecture (see p. 476).

Wyman & Sons, Photo-Litho

NEW ADMIRALTY

WHITEH

(Revi



C.t Queen St London.W.C.

AND WAR OFFICES.

ALL FRONT.

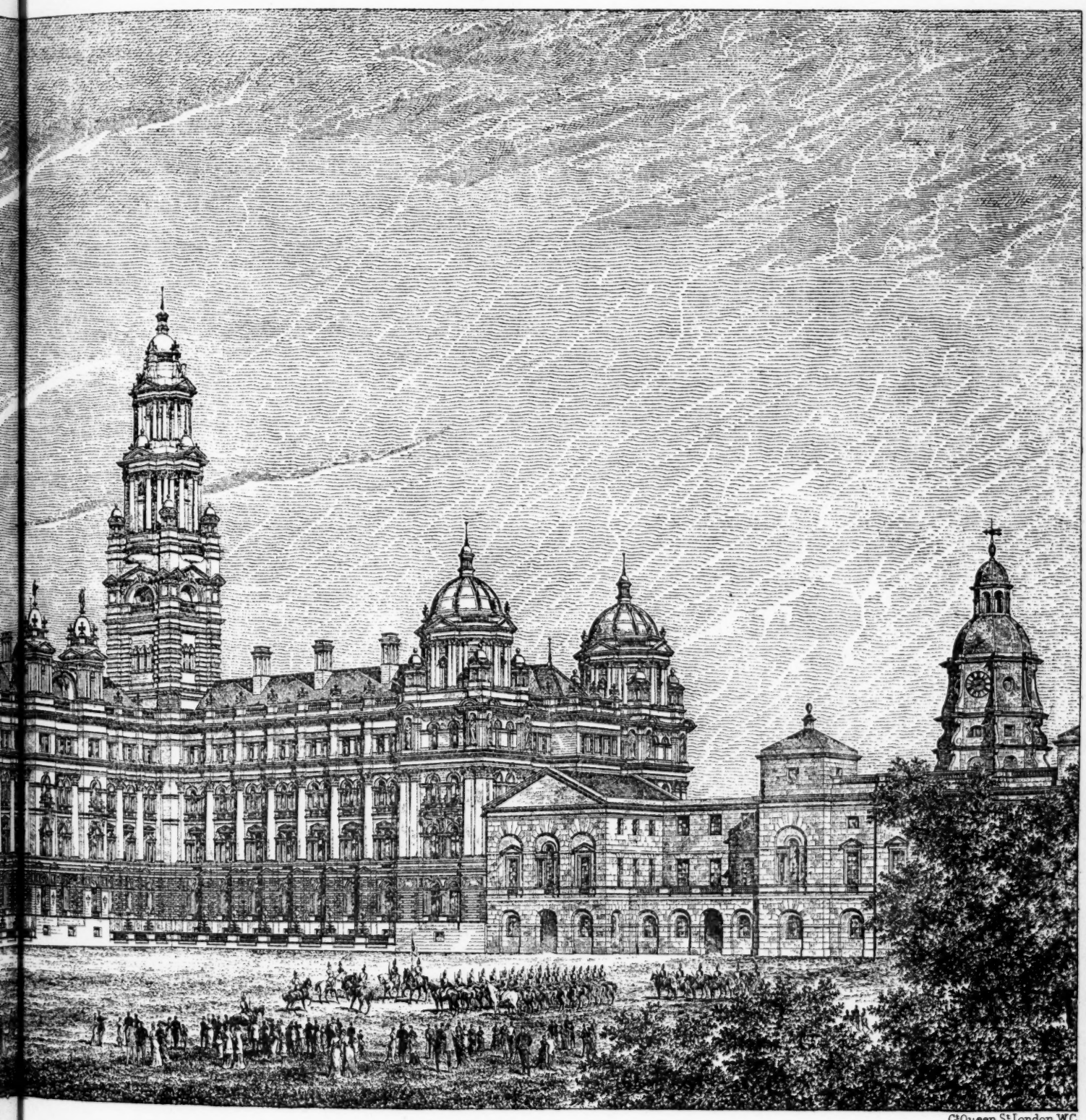
rised Design.)

Wyman & Sons, Photo-Litho.

NEW ADMIRALTY AN

ST JAMES'S PARK

(Revised Design

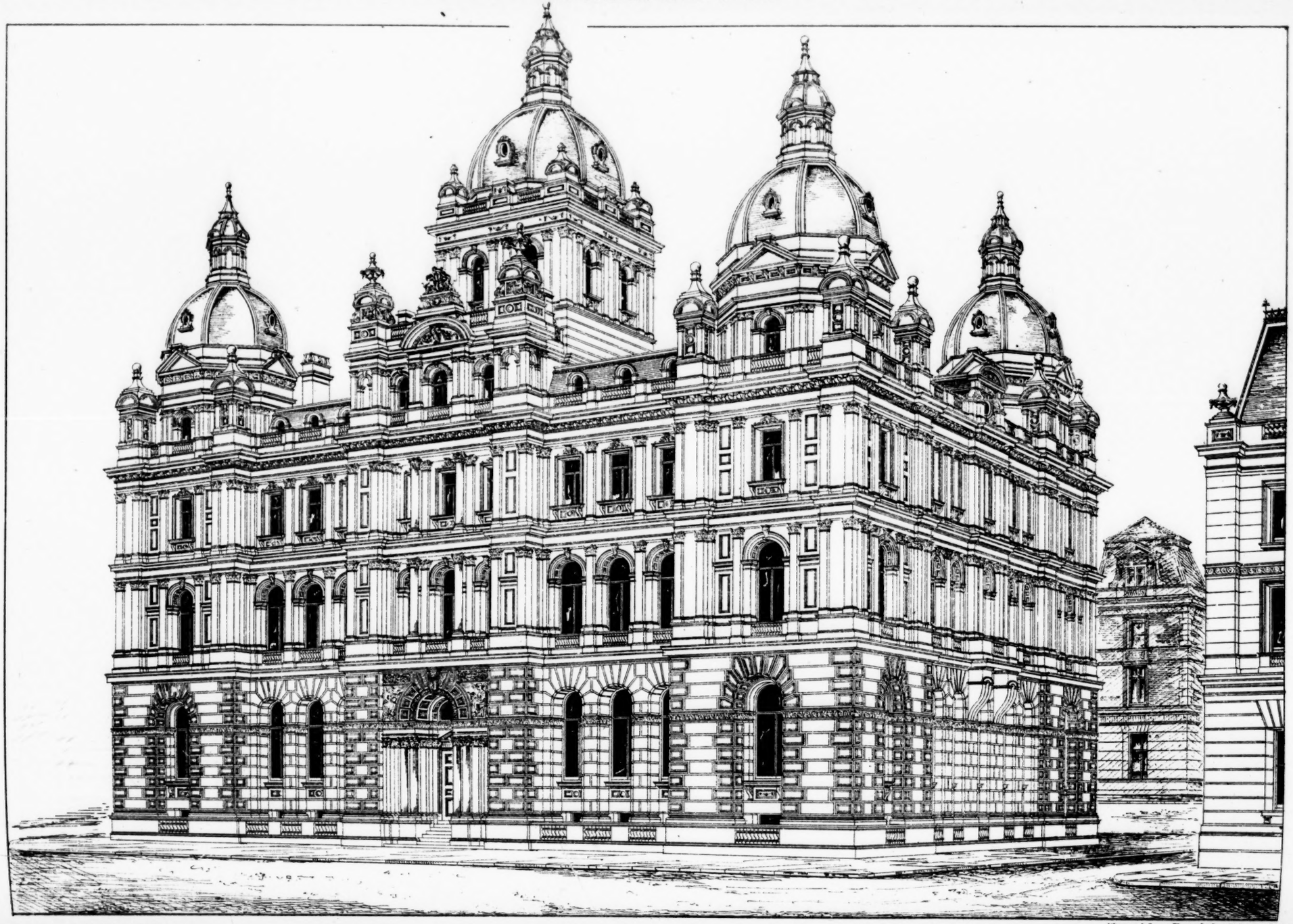


Ct Queen St London, W.C.

AND WAR OFFICES.

PARK FRONT.

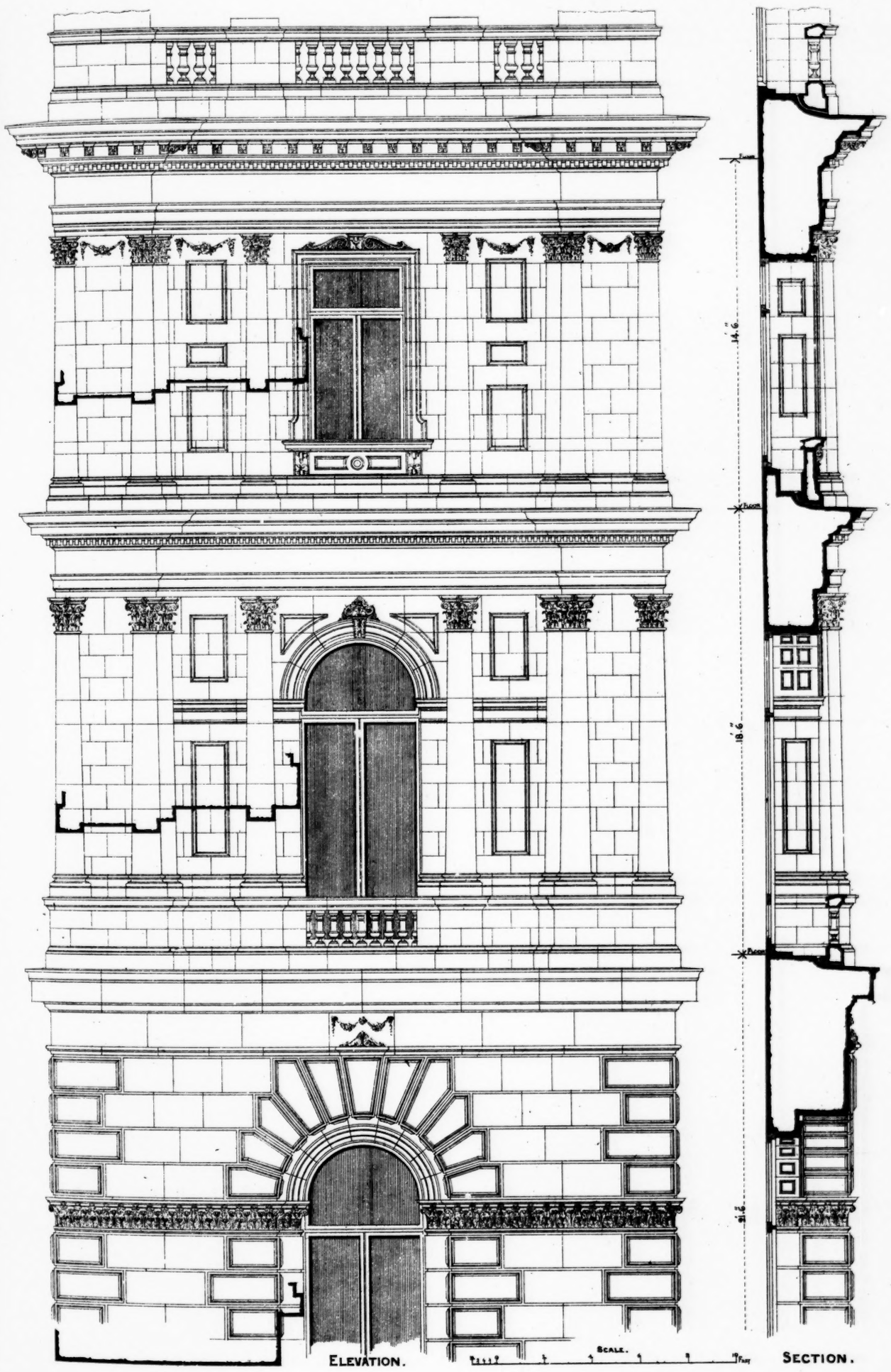
ind Design.)



Medal of Merit.
Soane Medallion Competition, 1885.

DESIGN FOR A MUNICIPAL MANSION.——By Mr. A. A. Cox. Perspective View.

Wyman & Sons, Photo-Litho, Gt Queen St.

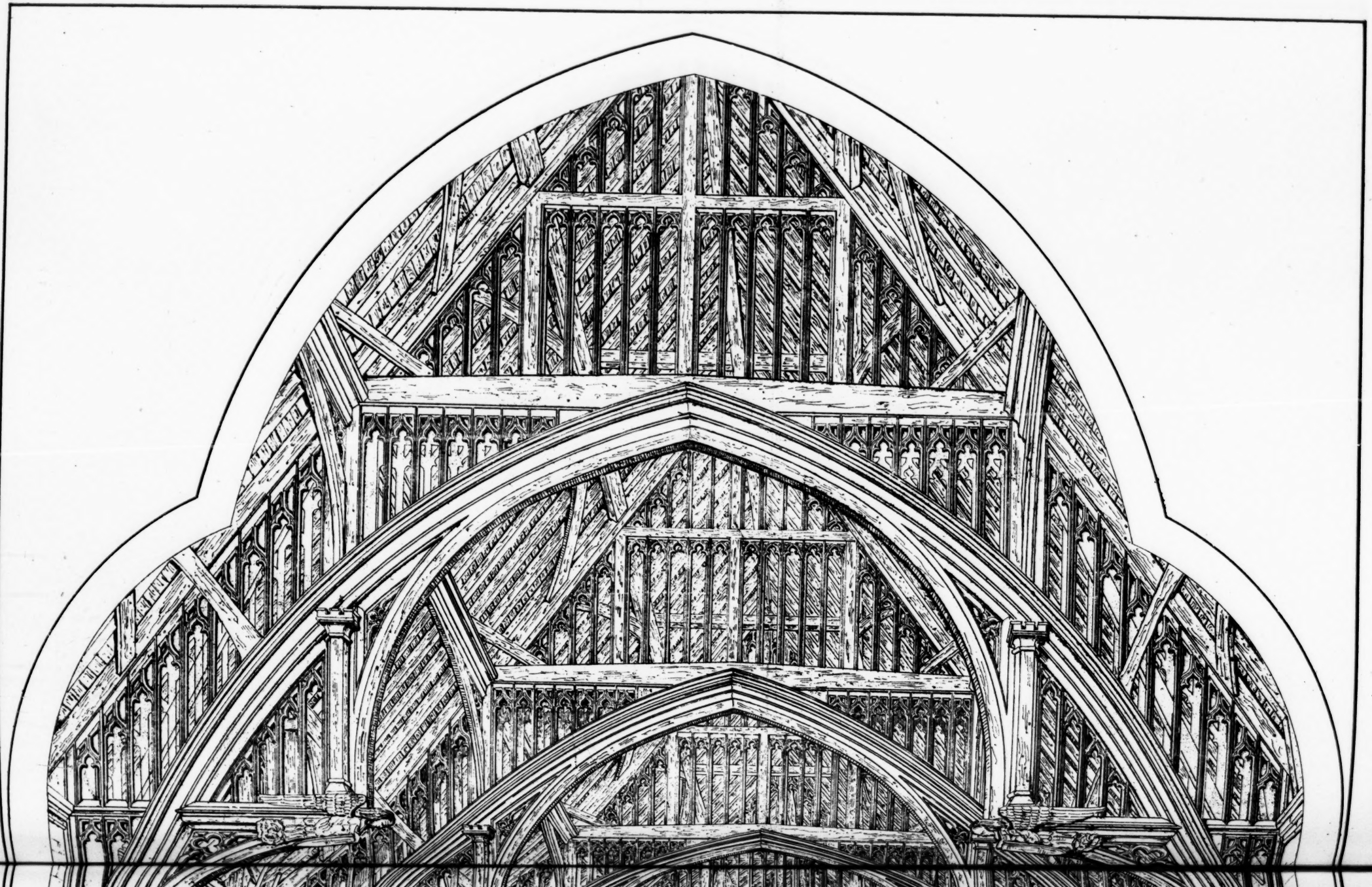


Wyman & Sons, Photo-Litho.

DESIGN FOR A MUNICIPAL MANSION.—By Mr. A. A. Cox.

Medal of Merit, Soane Medallion Competition, 1885.

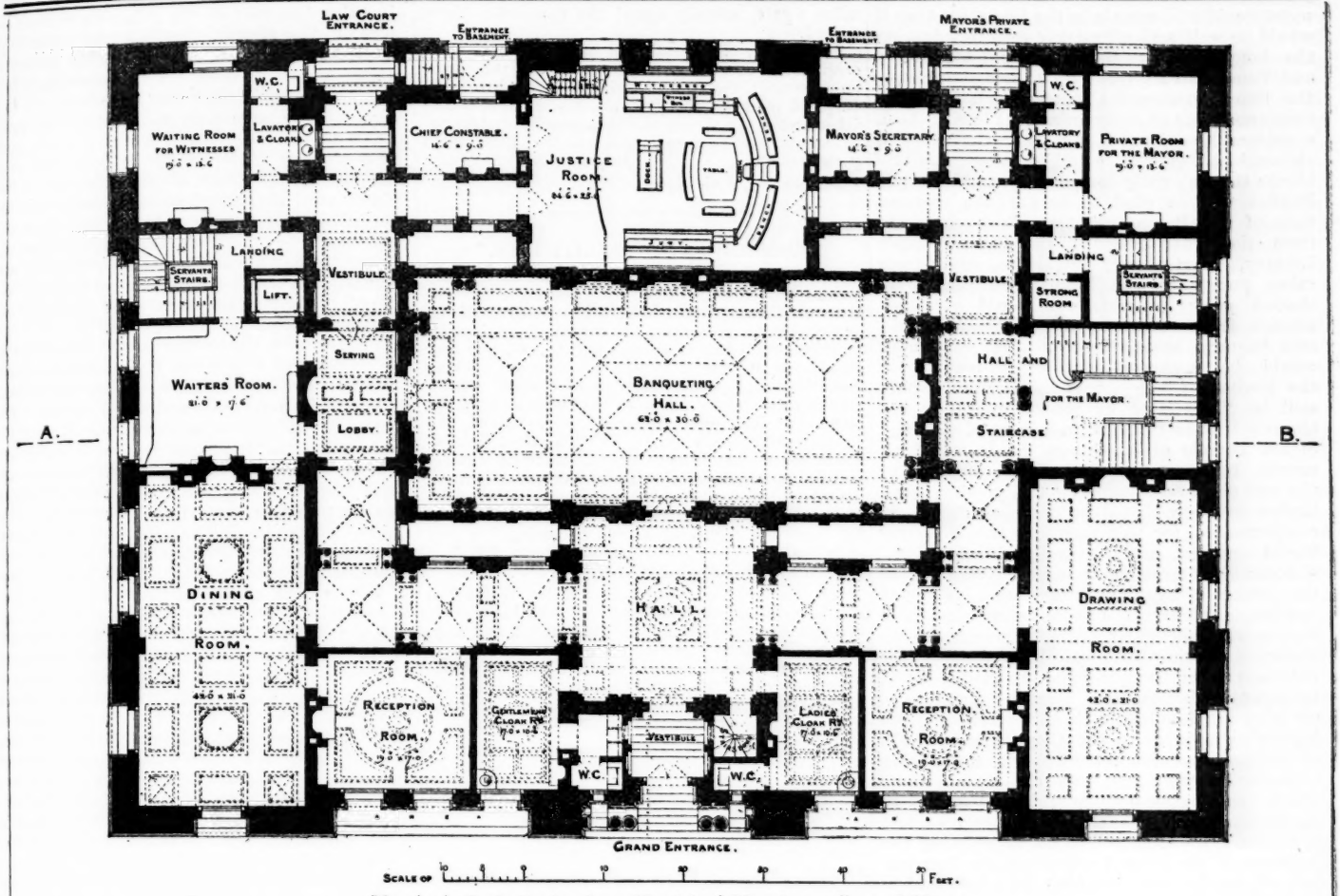
Detail of Portion of Towers (East Front).



Wyman & Sons Photo-Litho. C^t Queen S^t London W.C.

ROOF OF WESTMINSTER HALL.—From a Drawing by Mr. F. T. Dollman.

(Given in Illustration of Prof. Roger Smith's Lecture on "Roofs.")



Mr. A. A. Cox's Design for a Municipal Mansion.—Ground Plan.

DESIGN FOR A MUNICIPAL MANSION.

SOANE MEDALLION COMPETITION.

THE perspective view and detail which we give represent the design for the Soane Medallion by Mr. A. A. Cox, which obtained a medal of merit. The ground plan is appended. The building has more of the mansion and less of the town-hall about it than some of the other designs, and is a pleasing and dignified structure in general aspect; and the details, though showing nothing original, are carried out with refinement.

ARCHITECTURAL ASSOCIATION.

VISITS TO FISHMONGERS' HALL AND MERCHANT TAYLORS' HALL.

THE fifth Saturday afternoon visit for the present session took place on Saturday last, the 28th ult., to the Fishmongers' Hall, where a large number of members were received by Mr. Towse, the Clerk of the Company, at two p.m., and escorted by him through the different apartments. Mr. Towse described the various objects of interest belonging to the Company. The Fishmongers are the fourth on the list of the twelve great City Companies, and their hall was erected in 1831, on the site of the old hall, built by Mr. Jarman, the City Surveyor. The earliest extant charter of the Company is a patent of the 37th Edward III. Having inspected the several rooms, the members proceeded to the

Merchant Taylors' Hall.—This hall is situated in Threadneedle-street, and here a paper was read by Mr. W. Hilton Nash, giving a short description and history of it. This Company was incorporated in 1466. The hall is the largest of the Companies' halls, and was, like the Fishmongers' and Drapers' halls, rebuilt after the Great Fire, by Mr. Edward Jarman, the City Architect, who was also architect of the second Royal Exchange. The Association paid a former visit to the hall, March 6th, 1880, at which time very extensive additions were being made from the designs of Messrs. E. I'Anson & Son, architects, estimated to cost about 23,000*l.** The members having inspected the premises, from the very interesting crypt to the several chambers of the new buildings, including the strong room, containing the ancient silver "yard stick," formerly used at Cloth Fair, and the several "loving cups," &c., soon after took their departure.

* See *Builder*, March 13, 1880.

THE LONDON AND MIDDLESEX ARCHÆOLOGICAL SOCIETY.

AT a meeting of this Society held on the 24th ult., at King's College, Strand (Mr. J. G. Waller in the chair), Mr. G. L. Gomme, F.S.A., read "Some Notes on the Westminster 'Folk Moot,'" which was followed by some observations by the Chairman and Mr. Alfred White, F.S.A.

Mr. John E. Price, F.S.A., hon. secretary, next described some Roman and other pottery, coins, and various other objects of interest found during the recent City excavations. There was also exhibited the skull of a wolf of prehistoric times recently dug out of a depth of 16 ft. of gravel on the Albany Estate, Albany-road, Old Kent-road, in excavating for a sewer. The gravel commenced 2 ft. or 3 ft. from the surface. The skull was in a very remarkable state of preservation, and was evidently that of a young animal, the teeth being firm and white.

Mr. Price referred to the proposed restoration of the Church of St. Bartholomew the Great, West Smithfield, which was spoken of and illustrated by us last week. A discussion ensued, in which the Rev. W. Panckridge, the rector of the parish, Mr. Alfred White, F.S.A., and others, took part, Mr. A. White strongly dissenting from an opinion expressed by the late Mr. Parker that the fringe manufactory occupies the site of a Lady-chapel, his view being that this building was used for some other purpose. The general feeling was to waive any expression of opinion until the ground could be opened and more carefully examined, so as to ascertain what the building actually had been.

Mr. J. E. Price further announced that the Society had been in correspondence with the Chief Commissioner of Works in reference to the proposed restoration of Westminster Hall, and read a letter which they had addressed to him, stating that they had appointed a committee, consisting of Mr. C. B. Thurston, F.S.A., Mr. A. White, F.S.A., Mr. E. W. Brabrook, F.S.A., the President, Treasurer, and Secretary, to represent its views to the Parliamentary Committee if such were desired.* The conclusion they had formed was in the main in support of the conservative restoration which Mr. Pearson proposed, but they preferred the lower proposed form of cloister to the higher one. They also desired that no new building should be erected on the space set free by the demolition of the Law Courts, but that the wall and its buttresses might be left clearly visible. They thought it an additional objection to the higher cloister that it would render necessary the intrusion into the interior of the hall of a large and unsightly staircase. The majority of them objected to the raising of the north turrets, as merging the hall in the modern buildings around it. They thought it greatly preferable that its present outline should be preserved and be visible.

The view taken appears to be (as we might have expected) rather that of archæologists than architects.

* We understand that the Westminster Hall Committee has completed its public sittings, and is not to meet again until after the Easter holidays, when it will meet with closed doors to consider its report.

A SUGGESTED SITE FOR THE RE-ERECTION OF TEMPLE BAR.

SIR,—As a citizen of London, I take considerable interest in all that concerns the architectural monuments of the City, and I was, therefore, very pleased to see your protest (p. 441) in favour of the re-edification of Temple Bar,—the numbered stones of which are, I believe, still stowed away on some vacant land in the immediate vicinity of Farringdon Market, and not in Epping Forest, as seems to have been the impression at the Institute meeting. I sincerely trust that you will exert your influence to prevent so stupid a proceeding as the re-erection of the "Bar" in Epping Forest, where it would be an incongruity, severed from all its local and historical associations. Surely, rather than this, it would be possible to find some nook or corner for it within the precincts of those congeries of buildings which go to make up the Inner and Middle Temple? But better still would it be if it could be utilised as a gateway *to* the Temple, and I venture to point out what would seem to be a favourable opportunity for its utilisation in this capacity. As will be known to many of your readers, the easternmost entrance to the Temple is by a wretchedly-mean pair of wooden gates giving on to the open space in front of King's Bench-walk. My suggestion is that Temple Bar be re-erected on this spot, as it very easily could be by co-operation between two wealthy bodies like the Corporation of London and the Benchers of the Temple. The advantages of this site are (1) that the "Bar" could be re-erected with its old *façades* facing east and west respectively, as in its former position; (2) that this historic monu-

ment would still remain in the City; (3) that it would be well and effectively seen terminating the long vista westwards along Tudor-street and Temple-street from New Bridge-street,—the two first-named streets (which form one continuous line of communication) having been considerably widened by the Corporation, although at present a public-house partially blocks the way (only temporarily, as Mr. Wyke Bayliss will be glad to hear); the western face of the Bar would also show admirably from the south front of the Inner Temple Library, from Paper-buildings, and from other points of the large open and tree-shaded *place* to which it would give admission from the east; and (4) the historical and literary associations of the monument would be preserved, for, if re-erected in the position I suggest, the monument would still be "The Bar by the Temple,—by the Church that is founded in honour of God and of his Temple of Jerusalem."* It would, of course, be necessary that some portions of the two old houses flanking the present mean timber gateway should be demolished, but, as compensation for this sacrifice, the Benchers would get an architecturally-effective and historically interesting entrance, admitting of the passage of two lines of carriages, instead of one line as at present. I am not aware that these houses are particularly worth preserving on historical or other grounds. That some better entrance to the Temple from the eastward will be necessary before long must be apparent to all who are familiar with this improved and improving quarter of the City. Large blocks of buildings adjoining the Temple, and facing towards Temple-street and the new streets which run southwards from Temple-street to the Embankment, are already in progress, and it is therefore sincerely to be hoped that the benchers of the Inner Temple and the Corporation of London will combine to effect an improvement which will not only be architecturally effective, but which will restore to London,—and to that part of London, moreover, where it will be most appropriate,—a most interesting historical monument.

I trust, sir, that you will give early insertion to this letter, and that it may be thought worthy of attention by the authorities concerned.

London, March 30. Δ.

COLOURED PORTLAND CEMENT.

SIR,—Can you inform me of any means by which the Portland cement with which a brick house is to be coated can be made a *permanent red-brick colour*, so that the plasterer may lay on a coat of red cement instead of cement of the usual grey colour?

Perhaps the same means might be used which are employed to colour the red concrete slabs now in use, if any of your readers could enlighten me as to the process? "PORTLAND."

"STREET ARCHITECTURE OF LONDON."

SIR,—A letter appeared in your last issue [p. 465] from Mr. Wyke Bayliss on the above subject, in connexion with the new street which is being constructed between Bloomsbury and the Haymarket by the Metropolitan Board of Works. The writer does not express himself one whit too strongly on the point, and there can be no doubt whatever that by the course the Board has adopted the approach to the new street in question will be entirely spoiled, to say nothing of the dangerous corner which will be left. A requisition for the removal of the obstructing public-house has been signed by several influential ratepayers, and there is a very strong feeling on the part of the parishioners generally that it should go. Mr. Bayliss, writing as an artist, and on public grounds, does not appear to be concerned with local matters, further than asking whether there is a "*real lion* in the way," in the shape of some great landowner? Now, it is well known that the Duke of Bedford is the freeholder of nearly all the land in this quarter, and I am in a position to state positively that his Grace has not thrown any obstacle whatever in the way, but was willing to meet the Board in a satisfactory manner. As to other local facts, I may add that the lease of the public-house has but about twelve years to run, so that the cost of purchase could not be very extravagant. There are besides sixteen public-houses within the radius of about 150 yards. The "Black Lion," therefore, would not be particularly missed. The only other parties concerned, the owners of the adjoining building, of which a small portion would be required, and of which the Board has already taken a part, actually signed the requisition above named.

Last of all, the Board still have power in their original Act of Parliament to carry out this great improvement, the cost of which, compared with the 110,000*l.* paid for the Pavilion Music Hall, at the other end of the street, would be absolutely trifling.

The enclosed card will show you that I am an old parishioner and A LARGE RATEPAYER.

Bloomsbury, 30th March, 1885.

"ARSENIC AND ARCHITECTS."

SIR,—A letter from Sir E. Beckett has been widely quoted upon the danger of my poisoning congregations with arsenic when I apply it beneath the floors of a church for preserving the timbers from dry rot. I never specified or recommended its use, nor ever should use it, and I should much regret that an incautious reply to a clever man's "chaff" should give any ground for the idea that after all it might be used without great danger. I have, indeed, had to answer inquiries made to this effect in consequence of his letter. Sir Edmund is equally deluded in supposing that architects hate his useful little book, when they venture to smile at the idea of its ever superseding their office or their art, or at the probable result of a man becoming his own architect. WILLIAM WHITE, F.S.A.

30A, *Wimpole-street, W.*

*** It would have been better if Mr. White had stated more exactly what was the part he took in the matter, and what he did recommend, and why. We confess that we cannot quite reconcile his note with another which we read in the *Times*. He does injustice to Sir E. Beckett's sincerity in accusing him of "chaff."

Books.

Glass Painting: a Course of Instruction in the various Methods of Painting on Glass, and the Principles of Design. By FRED. MILLER. With numerous illustrations. Wyman & Sons, London (Wyman's Technical Series).

UNDER this title is presented to our notice a small work on "Glass Painting," purporting to be the result of the author's experience. The aim of the author has been, we presume, to compile a work which should treat of the historical technology of glass-painting; at least we would infer so much from the title. On an examination, however, we find the *matériel* of the work does not fulfil this liberal promise. The art of glass-painting described is an art entirely that of an artist, and not the art *par excellence*. We fail to see how it could be otherwise, as glass-painting (synonymous with glass-staining) is a most elaborate art, and one which, considered technically, apart from any theory of design, would occupy a work of much greater magnitude than that before us. This work is a collection of "hints" rather than principles. Generally, the work is not historical, the practical instruction in glass-painting is merely the method of the author, and as to the principles of design, we have illustrations of the author's and others; as to any theories or rules partaking of the nature of "principles," they are entirely absent. "Tools and Materials" are somewhat briefly described. A short chapter has been devoted to "Tracing and Staining."—staining, of a necessity, to be thoroughly treated would require a chapter to itself. Under the heading of "Enamels" we have a very slight notice of some English colours, &c. The information given could be obtained from any liberal trade catalogue. The ordinary division of an enamel colour into "flux" and "metallic oxide" is not noticed. The information given is of the slighest.

In order to make this work "reasonable," the scientific principles of the art should be gone into. For instance, "In the case of blue, green, and yellow ruby, a thin film of one of these colours is put on the other side. . . . . In adding stain to ruby, always do it on the side that is not flashed." This last is the only instruction as to staining "ruby" glass. Now, in point of fact, we have "streaked" ruby, which becomes darker in the kiln, and which is stained by water tinctured with the "silver" stain only. Again, ruby never improves in the heat. Some "antique" ruby becomes darker, and cheap flashed ruby usually becomes lighter, while being fired. Why is all this? Copper oxide is the colouring matter of these "rubies." Copper in its higher state of oxidation colours glass blue to bluish green; in the lowest oxide form (Cu_2O) it colours glass a dark "ruby." And as heat alone is sometimes sufficient to alter the character of the colouring matter,—a piece of glass almost colourless may after firing be almost opaque. The colouring power of copper begins at dark brown, becomes lighter as the higher oxides are being reached, till it is ruby, then salmon tint, next colourless, grey, and so on, to blue. When the artist has a good piece of ruby glass which he does not wish changed by the heat of the kiln, he mixes "flux" with his enamel colour in order that the said colour may fuse at a lower heat than will spoil the ruby. Now, the author has said almost nothing about the staining of ruby, and certainly has not described the character of a "flux." Again, no theory or principle of "firing" is apparent in this work.

We join with the author in his admiration of the writings of Pugin and Wyatt, whose efforts have conduced so much to revive the artistic feeling of industrial art and architecture. The author, in his introduction, evidently thoroughly appreciates the beauty of the early examples, and he is further to be congratulated on his perception of the true value of Munich glass. The argument is most apposite, and has been treated with some skill. The art is shown to have originated in the cloister, and the monk to have been the first glass-painter. In the early days of the art the clergy undoubtedly would perceive its influence on the mind and the invaluable aid it was likely to offer, as an important factor in captivating a mind rude and untaught. The great beauty of the art is shown to exist in the work being an expression of the devotional love of the artist, and never a mere example of skill. The first glass-painters had no precedent to guide them, and much labour must have been expended ere they could produce such effects as we may see existing yet. The motive of the earliest stained glass was to admit light; that is, light modified,—not the dazzling brilliancy of the sun, but a quiet, mellow radiance. Beauty of colour was the only merit of this early glass. To the primitive manner in which the work was carried on, we may ascribe the *reason* of its beauty. The author of the work in question has in no way entered into any consideration of the primary laws of form, colour, and composition of form. There are several minor details which would bear to be more fully considered, merely technical; these we may pass over. Several phrases, however, we may be pardoned for calling attention to. "The painting of every *other* square only never commends itself to me, as it suggests cheapness, and looks poor and thin." We cannot agree with this opinion. Alternate quarries in domestic stained-glass are so many points of interest, and when delicately treated, finely traced, and merely tinted with "yellow stain," form a very beautiful glass effect. Again, "A method frequently resorted to in church windows to give tone and softness to white glass is to mat each square, when traced, with umber or ancient brown. . . . . When dry, some of it is either rubbed off with the finger or with a stiff hog-hair brush. This plan is sometimes termed *antiquing* the glass, and is supposed to give the appearance of age. . . . . If this matting is done to deceive, it is certainly false, and should not be practised; but there is nothing illegitimate in the method itself." We consider this practice most reprehensible, and one which should not be tolerated.

In many of the designs shown in this work there is a certain super-elaborateness, not entirely in consonance with the character of the glass. Simplicity is a quality that cannot well be dispensed with. Glass-staining is entirely a conventional art, and "naturalism" is seldom in place. It is better to suggest merely some incident of plant life, than design a botanically correct adaptation of foliage, &c., trained by force into the regularity of glass and lead. Enamel colours never improve with age: their best period is when they are new. Stained glass is never stared at,—the light comes to us; the glass is a window, not a picture; the harmony of colour and beauty of form, with the train of thought excited in our minds by a mere suggestion, give us a pleasure which cannot easily be described. The chapter on ecclesiastical glass-painting enters concisely into the subject.

The illustrations, which are examples of old glass, for the most part, are bold and vigorous.

As the work purports to be practical, all historical notice could have been dispensed with, and a chapter or two added on the subject of theory and composition of "enamels" and "fluxes." This knowledge is, to a great extent, the basis of the practice of the art. The

* "Temple Bar,"—A Monograph by E. W. Godwin, F.S.A. London: 1877.

chemical formulæ of the various glasses should occupy a prominent position in a work of this description.

VARIORUM.

"The Architects' and Contractors' Handbook and Illustrated Catalogue of Materials and Manufactures," edited by J. Douglass Mathews (London: B. T. Batsford, 52, High Holborn. Liverpool: Harris & Co., Drury-lane), has reached its third annual issue. We reviewed the first issue at some length in the *Builder* on December 15, 1883, and we note that the editor has acted upon some of the suggestions which we made at that time. There are still a great many things not included in it, but in a compilation of this kind it takes time to get all the materials together. The work will be found exceedingly handy for reference, and is provided with two indices,—one to the materials and appliances themselves, and one to the manufacturers and merchants who supply them. —— "A Walk Through Lincoln Minster," by the Rev. Edmund Venables, M.A., Precentor of Lincoln (Lincoln: Ackrill, Ruddock, & Keyworth, printers), is a lecture delivered by the author to a local association. It gives an historical account and architectural description of the Minster, and will be found useful by visitors, although in saying this we by no means give our endorsement to all the author's views.——That the Electrician and the Electrical Engineer are finding increasing scope for activity and usefulness would be made evident (even if it were not otherwise apparent) by "The Electricians' Directory and Handbook for 1885" (London: *Electrician* Office, 1, Salisbury-court, Fleet-street), which embodies one or two improvements upon previous issues. A new and interesting feature, now introduced into the work for the first time, consists in a biographical section, in which brief biographies are given of those whose names are best known in connexion with electrical pursuits, in some cases illustrated with portraits. The work contains a great deal of useful information relating to dynamos, arc, and incandescent lamps, electrical formulæ, &c., as well as a directory of electricians and electric-light engineers.——"The Tenth Annual Report of the Cabmen's Shelter Fund" (London: Waterlow & Sons, London-wall), gives a summary of the progress made in the useful work in which it is engaged. Thirty-four shelters have now been placed in various parts of the metropolis, and they are used by 2,000 cabmen daily. It is stated that until these shelters were established the drivers had no means of obtaining refreshment or protection from the weather when on a cab rank, the police regulations prohibiting them from leaving the rank. Those of our readers who may be able to help the work of the Fund should address the Hon. Sec., Mr. Walter H. Macnamara, 15, Soho-square, W.—— A very useful Illustrated Catalogue has just been issued by Messrs. Treggon & Co., of Jewin-street, E.C., and Brewery-road, King's-cross. Besides being a catalogue of the multifarious articles and materials which are supplied by the firm, it contains some very handy trade memoranda, such, for instance, as the approximate weights per square foot and per sheet of zinc, copper, and black and galvanised iron. ——Mr. Edward Stanford, of 55, Charing-cross, sends us his "Catalogue of Maps and other Geographical Publications" published or sold by him, as well as "A *Résumé* of the Publications of the Ordnance Survey of England and Wales." Those who want maps of any part of the world will be sure to find what they need in these catalogues, while the information as to the publications of the Ordnance Survey shows the progress that has been made in that important work.——"Sell's Dictionary of the World's Press for 1885" (London: H. Sell, 167, Fleet-street) brings together in a convenient form a great deal of interesting and useful information as to the newspaper press of the world. It is illustrated with a large number of maps, studded with red dots at all points where newspapers or periodicals are published. We fail, however, to find any information in the work about the newspapers of Malta, although on one of the maps the island is almost obscured by one of the red dots in question. Nevertheless, the work appears, on the whole, to have been carefully compiled, and will be a welcome addition to the reference books of the counting-house or library.

CHURCH-BUILDING NEWS.

Stone (*Staffordshire*).—Christ Church, Stone, has been re-opened, after extensive additions and alterations. The church, which is a plain brick structure, was built about forty years ago. The old chancel, which was but 20 ft. by 13 ft. 9 in., has been removed, as also the former vestry. A great portion of the east wall of the nave has also been taken down. All the old pews have been cleared out, and the organ has been removed from the gallery. A new chancel, 30 ft. long by 20 ft. wide, has now been built. This is 25 ft. 6 in. high internally, and some 33 ft. to the ridge of the roof externally. It has a polygonal apse, five of the sides having windows the heads of which are filled with tracery. The chancel roof is composed of strongly-framed principals with curved ribs rising from the walls some feet below the cornice. The organ is to be re-erected in a spacious organ-chamber, which has been built on the north side of the chancel, into which, and the nave, there are wide and lofty arches for the double front with which the organ is to be re-arranged. The new vestry is upon the south side of the chancel, and is commodious and lofty. The nave and western gallery have been entirely re-seated with substantial seats of pitch-pine. In the chancel are oak choir-benches, with panelled fronts, an oak prayer-desk, and, on both the north and south sides, stalls for the clergy. The pulpit is placed so as to form the termination of the low screen wall by which the chancel has been extended into the nave somewhat beyond the line of the chancel arch above; the base is of Croxdon Abbey and Hazelstrine red stone, similar to that used for all the other internal masonry; above this base the pulpit is of the finest Painswick stone and veined alabaster. All the external masonry is of Hollington stone. The general works have been executed by Messrs. Lowe & Sons, of Burton-on-Trent, who also have supplied the pulpit and all the joinery, including the chancel seats and prayer-desk. The gasfittings have been manufactured by Messrs. Brawn & Co.; the brass chancel-rails, a new alms-dish, the frontal and cover of the Communion-table, and other furniture, are supplied by Messrs. Jones & Willis; and the heating apparatus has been remodelled and extended by Mr. Parkes, all of Birmingham. The chancel has been laid with encaustic tiles by Messrs. Minton Hollins & Co., of Stoke-on-Trent. The whole has been carried out under the direction and from the designs of Mr. W. Hawley Lloyd, architect, of Birmingham.

Waterloo (*Liverpool*).—A new set of choir-stalls in pitch pine, replacing the old and inconvenient fittings which before existed in the chancel of St. John's, Waterloo, a suburb of Liverpool, has just been erected by Messrs. Jones & Willis, of Birmingham and London, under the supervision of the architects.

Brierfield.—There has just been placed in St. Luke's Church, Brierfield, a new steam heating apparatus. The apparatus is fitted up on the gravitation principle, and is easily worked with a pressure of 15 lb. The boiler is in a cellar immediately below one of the vestries. The main pipe, which is 1½ in. in diameter, leaves the boiler, and is conducted in a flue at one time used for a hot-air apparatus (which was formerly the mode adopted for heating the church) into the body of the edifice, from which branches are taken of 1-in. pipes round the body of the pews in the centre aisle, and the east and west aisles. The steam is taken round in these pipes, and the condensed steam caused by circulation returned to the boiler. The apparatus has been provided by Messrs. Thos. Birtwistle & Co. (Limited), of Burnley. It is stated that this is the first church in the United Kingdom which has been heated by steam.

Hagbourne.—Some time ago it was decided to apply for a faculty to erect a plain oak reredos in place of the faded and dilapidated screen standing before the east window of the parish church. While the negotiations were pending, Sir Robert Loyd Lindsay came forward and proposed to erect a reredos at his expense. The offer was accepted, and the work is now completed. According to a local paper, the east window, though a very fine one, has, when entirely uncovered, quite spoiled the general beauty of the church, as it stretches the whole width of the chancel, and comes down very low indeed. It has been the object of the architect (Mr. Woodyear) to correct this. The wall, from the ground to the bottom of the window, has been faced with Bath stone, and the reredos proper has been built on to what was hitherto the thickness of wall inside the window-sill. On each of the outsides, north and south, is a narrow canopy divided in the centre, and having panels at the back divided into squares,—these are perforated, and display open work, through which the light can be seen. Next to these, on either side, are two wider canopies, divided from the others by columns projecting far out, and surmounted by a pinnacle and finial. The panels of these are also perforated. In the centre a much deeper and higher canopy, having on either side projecting columns with pinnacles, and at the back a diaper panel not perforated. Standing boldly out under this centre canopy is a white marble cross, and in the front of the whole is the super-altar, projecting some distance from the reredos, and 6 in. above the altar. All the work above the super-altar is done in Caen stone.

Poynton (*Cheshire*).—The church on Lord Vernon's estate at Poynton has now been completed by the erection of a tower and spire of simple Early Decorated character, corresponding with the rest of the church. The stone for the most part has come from Lord Vernon's quarries. The steeple has been built by Messrs. Ellis & Hinchcliffe, from the designs and under the superintendence of Messrs. Medland & Henry Taylor, architects, Manchester.

Queenstown (*South Africa*).—The opening and dedication of the nave of the Church of St. Michael and All Angels took place on Sunday, February 15th. The foundation-stone was laid on the 14th of November, 1882, by Sir T. C. Scanlen (then Premier of the Colony). The design is Early English, and the work of Mr. W. H. Reid, architect, Cape Town. The only portion opened at present is the nave, north and south aisles, and baptistery, covering a space of 85 ft. long and 45 ft. wide. The walls of the nave are supported by polished marble columns given by members of the congregation. With the object of making a temporary chancel a screen has been erected across the church,—thus forming a choir and sanctuary in the centre, an organ-chamber on the north, and a vestry on the south aisle,—which will all be removed on the completion of the chancel and transepts. The roof is 50 ft. from the floor, and has substantial principal rafters covered with diagonal boarding, all in pitch-pine, well oiled.

Kensington.—A richly-sculptured reredos has just been erected in St. George's Church, Campden Hill, as a memorial to the late Lieut.-Colonel D. W. Lawrell, R.A., by his wife. It rises to a height in the centre of about 13 ft., and occupies three sides of the apse, which has been newly decorated. The main features of the reredos are a sculptured representation of the Crucifixion and statues of St. Michael and St. George. The decoration of the arch was by Mr. Pullen, of Gray's Inn-road, and the reredos is by Mr. James Forsyth, of Finchley-road.

Headon (*Notts*).—The Church of St. Peter, Headon, near Tuxford, Notts, is about to be repaired under the superintendence of Messrs. Somers Clarke and J. T. Micklethwaite, of Dean's Yard, Westminster. The chancel was roofed, a new east window inserted, and the stonework throughout the church mercilessly scraped in 1858. The plaster then put upon the walls is in a worse condition than the old plaster still remaining on part of the nave walls. A flat plaster ceiling and new roof was put up over the nave some eighty years ago. This ceiling, much decayed, will be lined with boarding and panelled by ribs, the old bosses, many of which remain, being placed at the intersections. The pews, which are of the same date as the nave roof, and are arranged without a central alley, will be used for wall linings. The church is ultimately to be reseated with oak pews. The Jacobean pulpit retains its back-board and canopy; with this exception, there is not any old wood-work in the church. The repairs are to be executed by Mr. William Johnson, of Doncaster.

Sub-River Tunnel at New York.—At New York preparations are being made for the construction of a tunnel under the river East and Blackwell's Island, which, it is estimated, will be nearly one-fourth of a mile in length. The total cost of the tunnel will be, it is calculated, nearly seven per cent. less than that of a bridge.

The Student's Column.

DESCRIPTIVE GEOMETRY.—IX.

WE have already solved some problems by employing the method of *Rotations*. In this method the original projection planes are kept, and the object itself is made to girate round an axis. It is an operation very much easier to conceive than that of changing the projection planes, but in practice, except for a class of surfaces which we shall study hereafter, it leads to very much more complicated operations in drawing. In architecture many of the surfaces we shall have to deal with both in the delineating of shadows and in solving cases of masonry, belong to those where the method of rotations is the most convenient to use; therefore we must thoroughly master it by solving, through its means, simple problems on points, line, and plane.

Draw the new position occupied by the point a after rotating round the vertical axis O, *an angle measured by the arc* $\alpha\ \beta$.

In rotations the object rotated is supposed to be connected by a radius with the axis of rotation, just like the circumference of a wheel is connected by spokes with its axle. The amount of a rotation is given by the angle formed by the new and the old position of the radius of any point of the object rotated. The arc $\alpha\ \beta$, which measures the angle of rotation, has been given us on some definite circle round O, which we begin by drawing; this is the *measuring circle*.

We join a^h to O^h, and, as the radius a^h, O^h will move with the point a in the rotation of the latter we have only to mark the point γ where a^h O^h cuts the measuring circle; then carry the distance $\alpha\ \beta$ from γ to δ, and we have the new radius a^{1h} O^h, which gives us the new position of the point A. The student should note that in rotations the dash which indicates the second position of a point is put directly after the latter, whereas the signs ^{h} and ^{v}, which indicate the horizontal or vertical projections of the points, remain unchanged, as in a^{1h} or a^{1v}; if, on the contrary, the point does not

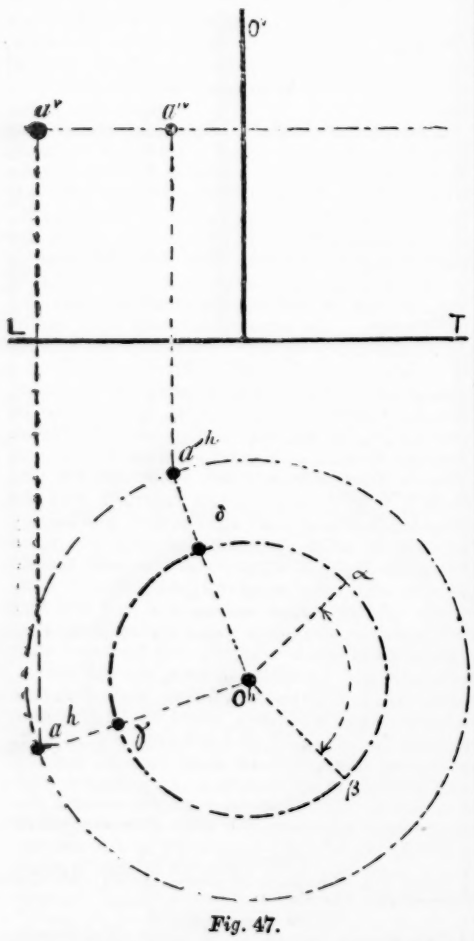


Fig. 47.

move, but new projections are made, we then put the dash to the signs themselves, ^{h} or ^{v}, as in a^{h1} and a^{v1}, thus clearly denoting the character of the transformation the point has undergone. This method of notation has been adopted in the *Builder*, as it offers greater facilities than any other to the reader in following out the explanations; but, when working drawings are made, those signs are in general dispensed with, or a shorter system of notation, such as a plain letter for the plan of the point, and the letter followed by a dash for its elevation, may be adopted. The lines should be drawn fine, our thick lines are only made to distinguish the various lines according to their importance. (See fig. 47.)

Draw the new position of the line D *after rotating round the vertical axis* O, *a given angle measured by the arc* $\alpha\ \beta$.

In the fig. 48 we have marked only o^h, the elevation of o being quite useless for our purpose. We could draw the rotation of any two points of D, and thereby get D in its new position D^1; but we spare ourselves drawing many lines by selecting for rotation the points a and b where D^h cuts the measuring circle; we then have only to carry the distances a^h, a^{1h}, b^h, b^{1h} equal to $\alpha\ \beta$, and draw the new elevations a^{1v}, b^{1v} to get the new projections D^{1h}, D^{1v} required.

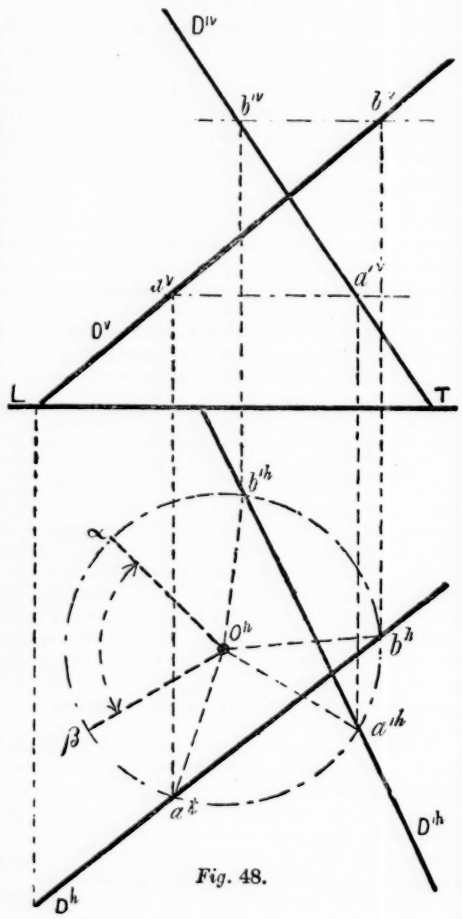


Fig. 48.

Draw the new position of the plane P *after rotating round the vertical axis* O, *a given angle measured by the arc* $\alpha\ \beta$.

As for the horizontal trace P^h of the plane P, it rotates like a straight line; you will draw it most easily by the means of the points a and b where it cuts the measuring circle. Where P^{1h} cuts L T we have, of course, a point of P^{1v}; to get another point thereof, we take a horizontal line, F, belonging to the plane P, we rotate F also according to the same angle $\alpha\ \beta$, and the point c where F^1 penetrates the elevation plane is also a point of P^{1v}. A notable simplification to the drawing is obtained by so selecting the horizontal line F that F^h pass over O^h, for after rotation the plan F^h of F^1 will, of course, still pass through O^h, which is the centre of rotation. Please note in fig. 49 that the points a and b, as well as c, have no signs ^{h} or ^{v} tacked on to them, because they are not the projections of a, b, and c, but the points themselves. (See fig. 49.)

For the sake of clearness we have made separate diagrams for each operation of rotating a point, a line, and a plane, but in practice we will probably have to carry out the three operations simultaneously on the same drawing.

Draw the new position of an object after rotating round a horizontal axis, O, *a given angle measured by the arc* $\alpha\ \beta$.

We have already seen that to obtain any new projection we may wish of an object, two rotations are required, the axes of which are at right angles with one another; the one axis is vertical, the other is perpendicular to the elevation plane, for they are the only rotations

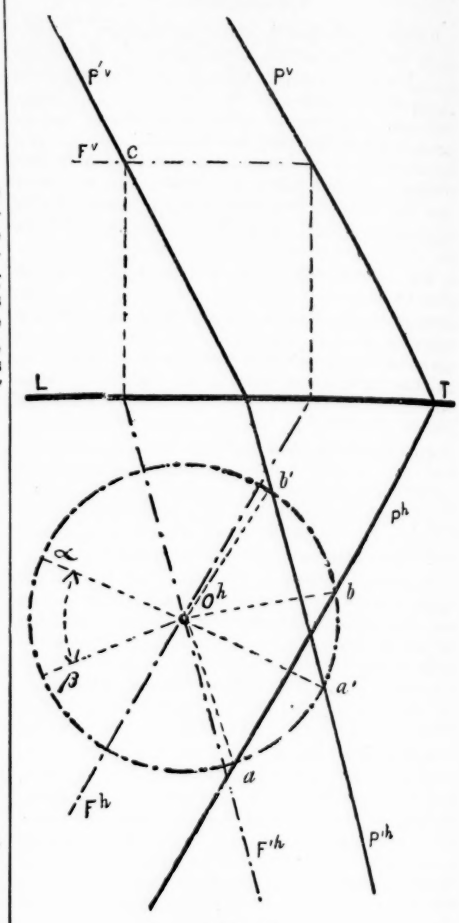


Fig. 49.

we can draw readily. The student must, therefore, exercise himself in drawing horizontal rotations as well as vertical ones. There is no difficulty in doing so; we have only to turn the

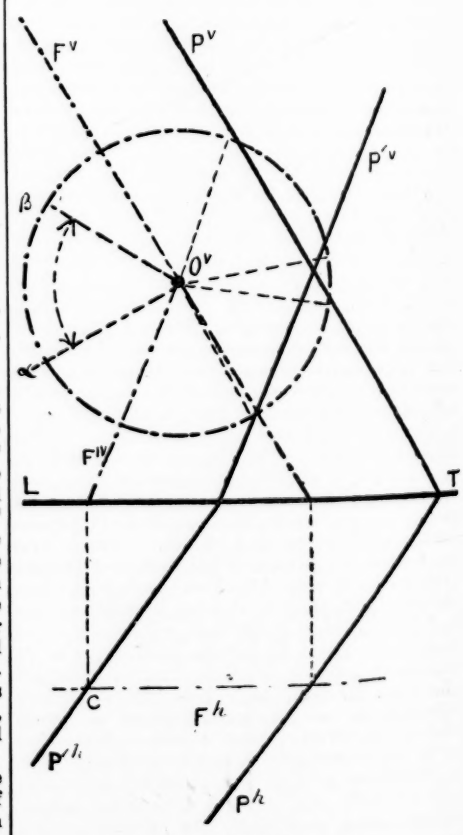


Fig. 50.

drawing upside down to find that the operation is identical with the preceding one. We will limit ourselves to drawing in fig. 50, the rotation of a plane, P, round a horizontal axis without giving any further explanations.

RECENT PATENTS.

ABSTRACTS OF SPECIFICATIONS.

899, Water Waste Preventer for Water-closets, &c. F. C. Biddiscombe.

The cistern is divided into two parts,—upper and lower. The upper one is filled with the usual valve and ball float. The second or lower one is filled by a hole in the partition plate. The second cistern has two cylindrical chambers, one closed by a plate and the other by a plunger. The pull-lever works the plunger, which, on its descent, forces the water up the other chamber and the water starts a syphon which empties the lower cistern. An after-flush can be obtained by placing another syphon within the first, but of much smaller dimensions, the shorter leg of which extends into the cistern below that of the first syphon.

526, Pavements, Wall Surfaces, &c. J. H. Chavasse.

This invention consists in constructing surfaces by the use of tiles, bricks, or blocks, the whole or part of the edges of which are curved. Borders and patterns made up of tiles of simple shape, having one, two, or three curved edges, may be combined with the pavement.

874, Steam Boilers. J. Calverley.

An additional furnace flue is provided in the lower part of a Lancashire boiler to displace water and provide for more uniform heating.

286, Cistern Ball Valves. E. Brock.

The outlet is turned downward, and the valve closes upwards, against an inverted seat. A bent rod, with a slot in the upper end, has its longer arm guided vertically by lugs on the outside of the body of the valve, and the ball-lever passes through the slot. The valve is attached to the shorter arm, and is in the form of a truncated cone, with a covering of indiarubber stretched over it.

4,083, Brushes. S. Morley.

Whitewashing-brushes for railway cattle-trucks and for other purposes are made with a hollow handle, through which passes a tube terminating at the head of the brush in a small T-piece, from which small tubes pass through the brush to the bristles. The liquid to be used is supplied from an elevated tank, and a tube runs either through a hollow handle, or on the outside of a solid handle, to supply the brushes.

7,230, Door Letter-box. G. W. Potter.

The sides and top and bottom of the letter-box are made of flexible material, so as to allow the door to be fully opened. The back is rigid, and contains an aperture through which the letters are removed.

12,036, Nails. J. J. James.

The improvement consists of a shoulder turned out of the shank, and which supports the head of the nail squarely. The shoulder is formed by a recessed stamp operating upon the end when the shank is held by countersunk gripping dies.

APPLICATIONS FOR LETTERS PATENT.

March 20.—3,585, G. Wolff, Wood Stain.—3,592, P. Jolin, Improvements in Electric Bells.—3,604, J. Anderson, Self-regulating Water Waste Preventer.—3,607, G. Sowerby, Improvements in Ventilators for Buildings.

March 21.—3,650, B. and D. Cross, Waste Preventing Cisterns.—3,651, W. Green, Noiseless Revolving Chimney Cowl.—3,656, F. Rogers, Improved Vane and Indicator.—3,660, J. Lewis and C. Rawlings, Improvements in Fire Grates and Stoves.—3,661, A. Stephens, Apparatus for Supplying Water to Water-closets, Urinals, &c.

March 23.—3,692, T. Lowe, Smoke-consuming Apparatus.—3,707, G. Stephens, Opaque Stained Glass for Wall Decorations, &c.—3,711, J. Kretschmann, Water-closet Valves.—3,714, C. Portway, Improvements in Fences, Dividing Walls, and such like Structures.—3,721, A. Emanuel, Oblong Syphon Noiseless Water Waste Preventer Cistern.—3,723, J. Barrett, Apparatus for Opening and Closing Doors in connexion with Hoists.—3,749, R. Pyne, Protective Safety Door Fastener for internal use.

March 24.—C. Hardiman, Chimney Pots or Tallboys.—3,757, W. Miller, Wash-hand Basins or Lavatories.—3,772, C. Unger and P. Gerlach, Improved Cooking Stove.—3,780, R. Pyne, Fasteners for Casements, Sashes, Doors, &c.—3,787, G. Pegram, Improvements in Trusses for Bridges, &c. 3,802, W. Johnson, Improvements in Walls, Partitions, Roofs, and other similar Structures.

March 25.—3,823, J. Baber, Apparatus for Printing Dados on Walls, Ceilings, &c.—3,828, B. Walker and Others, Machinery for Forging or Shaping Nails.—3,836, W. Brown and H. Clayton, Construction of Sinks and Traps.—3,839, E. Gardner, Manufacture of White Lead.—3,840, H. Heron, Ventilating Closet, Soil Pit, or Privy, applicable also to Dust Bins.

March 26.—3,875, H. Ibbotson, Opening and Closing Sash Windows.—3,884, H. Haddan, Improvements in Window Fastenings.—3,897, J. Johnson, Manufacture of Artificial Stone.

PROVISIONAL SPECIFICATIONS ACCEPTED.

1,185, H. and T. Sanders, Improvements in Locks.—1,340, W. Gedge, Machine for Cutting, Planing, or Shaping Wood.—2,036, W. Ellis, Machine for Cutting Laths, Veneers, &c.—2,408, C. Harvey, Ventilating Sewers, Drains, Cesspools, &c.—2,810, J. Watterworth, Improved Ornamental Panel Work.—2,917, L. Groth, Heating and Disinfecting Apparatus for Urinals or Privies.—2,933, W. Hayward and W. Eckstein, Cellar Covers and Coal Plates.—3,065, P. Simons, Improved Tile.—3,130, J. E. and F. B. Rendle, Improvements in Glazed Structures.—3,248, D. Sugg, Inverted Gas Burner.—1,476, W. Walton, Apparatus for obtaining quick and easy Access to the Summits of Tall Chimneys, Shafts, Spires, Lofty Buildings, &c.—3,270, G. Losekann, Mixing Ingredients for Colours.—2,775, W. Donald, Manufacture of Refractory Materials and Bricks.—2,977, A. Kohlhofer and J. Haller, Construction of Domestic Stoves.—3,334, J. Humphrys, Automatic Gas Heating Apparatus.

COMPLETE SPECIFICATIONS ACCEPTED.

Open to opposition for two months.

8,372, J. Gill, Chisels and Gouges.—8,747, A. McLean, Moulds for Moulding Decorative or other Slabs and Blocks.—9,926, W. Lake, Improvements in Bridges, Piers, and similar Structures.—2,304, J. Turner, Material for Covering and Decorating Walls, &c.—2,365, F. Podany, Adjustable Planes for producing Parquet Flooring in various kinds of curvilinear designs.—2,424, T. Dykes, Improvements in Girders.—2,457, J. Campbell, Improvements in Ladders or Steps.—2,492, F. Humpherson, Waste Water Preventer.—6,562, R. Bowles, Stove for Warming and Ventilating.—7,948, G. Nebeling, Metallic Coverings for Roofs and Walls.—8,212, E. and A. Ashby, Apparatus for Deodorising the Fumes of Cement and other Kilns.—14,742, J. Cornelius, Improved Cistern.—2,684, P. Hedderwick, Appliance for using a Closing Cooking Range as an open Fire.—2,687, J. A. and J. Hopkinson, Hot-Water Apparatus.

RECENT SALES OF PROPERTY.

ESTATE EXCHANGE REPORT.

March 18.

By Hards, Vaughan, & Jenkinson.

Greenwich — 44, Ashburnham-grove, 94 years, ground-rent 5*l.*	£375
Nos. 1 and 2, High Bridge, and 1 to 4, Crown-court, 74 years, ground-rent 15*l.*	295

March 23.

By W. Holcombe.

Stockwell — 266, South Lambeth-road, 31 years, ground-rent 11*l.*	515

By L. Farmer.

Kentish Town — 73, Weedington-road, 72 years, ground-rent 7*l.*	390

By J. K. Coleman.

Stepney—316 to 324 even, Oxford-street, 62 years, ground-rent, 20*l.*	1,660

By E. E. Croucher & Co.

Elstree — Two enclosures of freehold land, 11a. 3r. 35p.	1,940
Thatched cottage farm, 37a. 1r. 21p., freehold	2,600

March 24.

By G. Gouldsmith, Son, & Co.

Belgrave-square — 17, Chesham-street, 38 years, ground-rent 30*l.*	4,300
Regent-street — No. 261, term 34 years, ground-rent 61*l.* 12s. 6d.	1,830
No. 273, 37 years, ground-rent 63*l.* 2s.	1,410
Marylebone-road—27, Nottingham-place, 6 years, ground-rent 14*l.* 14s.	450

By Debenham, Tewson, Farmer, & Bridgewater.

St. Giles's, Queen-street—Ground-rent of 67*l.* 10s. a year, reversion in 78 years	1,400

By A. Walton.

Hammersmith — 3 and 5, St. Peter's-grove, 41 years, ground-rent 5*l.*	375
Nos. 7 to 13 odd, St. Peter's-grove, 41 years, ground-rent 8*l.*	720
Forest-gate—102, Sebert-road, freehold	415

By F. Jolly & Co.

Pimlico—11 to 14, Gregory-street, 36 years, ground-rent 16*l.*	740
Gray's Inn-road—49, Acton-street, 53 years, ground-rent 5*l.*	505
Homerton—92 and 94, High-street, and 20, Rosina-street, 65 years, ground-rent 12*l.*	660
Islington—105, 107, and 109, St. Peter's-street, 60 years, ground-rent 6*l.*	845
Hoxton—35, Hemsworth-street, 43 years, ground-rent 5*l.* 5s.	320

By A. Watson.

Portland-place—20, Devonshire-place, 3 years at 42*l.*, and 32 years at 150*l.* a year	3,000
Oxford-street—A profit rental of 200*l.* a year, term 18 years	1,950
Regent's Park—16, Primrose Hill-road, 80 years, ground-rent 7*l.*	2,000
Kilburn—2, 6 to 10 even, and 9, Garlinge-road, 94 years, ground-rent 46*l.*	3,580
Nos. 12, 14, and 16, Garlinge-road, 97 years, ground-rent 24*l.*	1,990

By Worsfold & Hayward.

Dover — 3, Camden-crescent, 53 years, ground-rent 10*l.*	1,060
No. 9, Norman-street, leasehold	325
Buckland, 294, London-road, freehold	930
Buckland, 293, London-road, freehold	320
Buckland, two plots of freehold land	175
Nos. 22 and 23, Waterloo-crescent, 50 years, ground-rent 20*l.*	3,025
Nos. 3 and 9, Esplanade, 53 years, ground-rent, 2*l.* 9s. 6d.	1,045

March 25.

By J. Baker & Wilkinson.

Camberwell — Ground-rents of 322*l.* 15s. a year, reversion in 77 years	£8,400
Kennington—Ground-rents of 37*l.* 8s. a year, reversion in 38 years	1,420
Ground-rents of 25*l.* a year, reversion in 38 years	1,060
Ground-rents of 15*l.* a year, reversion in 39 years	490
Ground-rents of 26*l.* a year, reversion in 40 years	860
Shepherd's-bush—Improved ground-rents of 99*l.* a year, term 78 years	1,920
Paddington—Improved ground-rents of 176*l.* a year, term 78 years	3,400

March 26.

By A. Parish.

Croydon—4 to 11, Bridge-terrace; 1 to 5, Coleshill-terrace; and "Bridge House," freehold	3,040

By A. Young.

Shepherd's-bush, Malpas-road—A plot of freehold land	760

By Wagstaff & Warman.

Southgate, Avenue-road—The freehold residence, "Chase Bank"	1,350

By Woods & Snelling.

Stepney—13, Devonport-street, 57 years, ground-rent 2*l.* 10s.	430
Chelsea — 31, Gertrude-street, 75 years, ground-rent 6*l.*	445

By Bean, Burnett, & Eldridge.

Battersea—6, Northcote-road, and 19 to 25 odd, Abyssinia-road, freehold	2,240
Shortlands, Beckenham-grove—The freehold residence, "Fairlie"	1,625

By Newbon & Harding.

Islington—13, Morten-road; and 1 to 8, Lindsey-cottages, 55 years, ground-rent 50*l.*	300
Limehouse—26 and 28, Ropemakers'-fields, freehold	300
Hoxton—20 and 21, Parr-street, 24 years, ground-rent 10*l.* 10s.	510
Nos. 44 and 45, Shaftesbury-street, 18 years, ground-rent 8*l.*	285
Nos. 108 and 116, St. John's-road, 25 years, ground-rent 9*l.*	725
Sydenham—34, Kent House-road, 52 years, 10*l.*	90

By E. Stimson.

Peckham—6, Maria-terrace, freehold	305
Ground-rents of 48*l.* a year, term 78 years	820
Old Ford—Ground-rents of 30*l.* 2s. a year, term 78 years	530
Brixton—51 and 53, Bishop's-road, 75 years, ground-rent 8*l.* 10s.	405
Hackney—5 and 6, Queen Caroline-place, 32 years, ground-rent 4*l.*	250
Islington—40, Ellington-street, 67 years, ground-rent 8*l.*	410
Camberwell—1 to 7, Rust-square, 73 years, ground-rent 44*l.* 2s.	2,170
New Cross—13 and 19, Somerville-road; and a ground-rent of 3*l.* 10s. a year, 65 years, ground-rent 10*l.* 10s.	560

By C. C. & T. Moore.

St. George's-in-the-East—355, Cabel-street; and 1 and 2, Cowley-street, 29 years, ground-rent 10*l.*	605
Hackney—89 and 91, Weymouth-terrace, 29 years, ground-rent 3*l.* 10s.	410

March 27.

By Blake, Haddock, & Carpenter.

Mitcham, High-street—The King's Arms, and 2, High-street, freehold	1,500
Freehold house adjoining	830

By Baker & Sons.

Greenhill, Harrow—Freehold land, 17a. 3r. 6p.	1,170
Epsom, Pitt-place—Freehold land, 1a. 2r. 38p.	1,000
Marylebone-road—118, term 35 years, ground-rent 4*l.*	630

By R. Reid.

Piccadilly—12, term 33 years, ground-rent 56*l.* 3s., land-tax 4*l.* 10s.	3,810
Kingston-on-Thames—House and shop, 77 years, ground-rent 20*l.*	1,110
Camden-square—26, South-villas, 78 years, ground-rent 11*l.*	580
No. 27, North-villas, 78 years, ground-rent 11*l.*	540
Tufnell Park—15 and 17, Anson-road, 81 years, ground-rent 12*l.* 12s.	870

By Rushworth & Stevens.

Islington—357, Liverpool-road, 24 years, ground-rent 5*l.*	310
Camden-road — 5, Wellington-street, 26 years, ground-rent 4*l.*	275
Dorset-square—6 and 7, Little Park-street, 16 years, ground-rent 10*l.*	240

By Frank Lewis & Co.

Pimlico, Ponsonby-place—The lease of the Ponsonby Arms	450
Regency-street—The lease of the Star Beer-house	350
Peckham—27 to 37 odd, Asylum-road, 24 years, ground-rent 18*l.*	570

MEETINGS.

Saturday, April 4.

Edinburgh Architectural Association.—Visit to Rosslyn Castle and Chapel.

Monday, April 6.

Leeds and Yorkshire Architectural Society.—Election of Officers and Presentation of Report and Balance Sheet.

Edinburgh Architectural Association.—Mr. D. Purves on "House Drainage and the Sanitary Arrangements Connected therewith." 8.30 p.m.

Inventors' Institute.—8 p.m.

Tuesday, April 7.

Northern Architectural Association (Newcastle-on-Tyne).—Quarterly Meeting.

Wednesday, April 8.

Civil and Mechanical Engineers' Society.—Mr. David Gravell on "The Markets of the Metropolis." 7.30 p.m.

Thursday, April 9.

Architectural Association.—Members' *Soirée.* 7.30 p.m.

Friday, April 10.

Institution of Civil Engineers (*Students' Meeting*).—Mr. S. Tomlinson "On Machines for Crushing Stone and other Hard Materials." 7.30 p.m.

Saturday, April 11.

Architectural Association.—Visit to the Northumberland Avenue Hotel. 3 p.m.

Miscellanea.

The Farringdon Vegetable Market.—The *City Press* states that the Markets Committee have recently viewed the site of the fruit and vegetable market in Farringdon-street. It is proposed either to re-model the market, or to entirely re-build it. One thing is certain, the time has arrived when something must be done. The general opinion of those connected with the market is, that nothing short of an entire new building will be of any permanent service. Those who know the dilapidated and forlorn condition of the buildings will be disposed to coincide in this opinion. We notice that Mr. Thomas Rudkin, who is especially conversant with the requirements of the City in regard to market accommodation, proposes that the whole of the area available for market purposes should be excavated to 20 ft. below the level of Farringdon-street; that the basement should be so constructed as to be adaptable for stabling for at least 200 horses,—a requirement much needed by market-gardeners and others bringing their produce to the market; the remainder to be used as stores for the tenants. The entrance to the basement would be (according to Mr. Rudkin) from Farringdon-street. The market itself would be on a level with Farringdon-street, and would be, practically, the same shape, and its carriage entrances and exits in the same form, shape, and position, as the new Central Fish Market, Farringdon-road. The whole of the market area could be covered with a light iron and glass roof. Wagons and other vehicles would be able to pass in and out of the market at either of the three entrances, namely, Stonecutter-street, the present entrance in Farringdon-street, and at a third entrance to be provided. In addition to this, Mr. Rudkin thinks that the market scheme should, in the interest of the public, as also in that of the Corporation, as landlords, be supplemented by constructing on three sides of the site, over the market, viz., the south, north, and east, a range of buildings as dwellings for the working classes, and on the western, or Shoe-lane side, a row of shops or warehouses. This part of the scheme would, of course, be distinct from the expenditure on or construction of the market.

Water Supply in the West of England. Mr. Arnold Taylor, Local Government Board inspector, has been holding an inquiry at Tiverton Town Hall with reference to the application of the Council for sanction to borrow 2,000*l.* to enable them to carry out the scheme prepared by Mr. Robert Ellis, water bailiff, for improving the water supply of the town. Mr. Ellis described his plan, explaining that it was proposed to construct new works near the site of the present, on a piece of ground named "Allers Copse," belonging to Sir John Heathcote-Amory, Bart., and situated about two miles and a half from the town. The supply would be taken from the main stream at a point just under How Farm, and about 400 yards above the settling-tanks. Filtering beds would be provided, and he proposed to utilise the present works as a service reservoir.——We learn that Torquay, Newton Abbot, St. Mary Church, and Cockington are just now in an exceedingly satisfactory condition as regards their water supply. The new reservoir constructed by the Torquay Local Board, at a cost of about 30,000*l.*, is now filled to a height of 24 ft. 6 in., and contains 120 million gallons. The old reservoir, a short distance below, is quite full, and holds 103 million gallons, so that at the present moment there is an available supply of water stored in the two reservoirs of no less than 223 million gallons. It is anticipated that the new reservoir will be quite full in six weeks, and that soon after that time the deferred celebration of its construction will in all probability be held. The work of duplicating another section of the water main, at a cost of 5,000*l.*, is now so far advanced that the whole of the pipes will be laid and in working order by the middle of April. This further extension of the mains will increase the supply by 200,000 gallons a day, making the total daily supply 1,200,000 gallons, which is equal to about 30 gallons per head of the population.

Partnership. — Mr. Henry H. Leonard, Quantity Surveyor, of 202, Bishopsgate-street Without, announces that he has from Lady-day taken Mr. Stanley Clarke into partnership, and that the style of the firm will be "Leonard & Clarke."

York Architectural Association.—At the fifth meeting of this Association for the present session, Mr. R. A. Parkin, of York, gave a lecture on "Building Construction," in the course of which he referred to the varying solidity of the earth which formed the foundation for the building, and showed how to overcome inequalities in the foundations. Referring to the construction of walls, he remarked that brickwork could never be crushed by fair means. If the foundation was good, and the areas were all gone into, it was almost impossible to build a building high enough to crush brickwork. There were three classes of walls,—the massive, the substantial (3 ft. to 4 ft. thick), and the walls built to the precision required by the science of to-day. He would only deal with the third class of walls, as the other two were wasteful. A straight wall would give way at the bottom, a wall arched at one end and supported at one end would turn and fall inwards, while a wall with a binding piece at each end would have the greatest pressure in the centre. While speaking of the thickness of walls, he remarked that the scientific construction of the walls was never considered at all by some people building them; they generally built them thick enough to stand, and, of course, the builder had to pay the cost.

An Auger to Bore a Square Hole.—An American paper states that the first and only auger ever manufactured that will bore a square hole is now in the shops of the Cleveland Machine Company. This auger bores a 2-in. square hole, the size used in ordinary frame buildings and barns, but it can be made on the same principle to bore square holes any size. Its application is the ordinary one, and it works on the same principle as round-hole augers. Its end, instead of having a screw or bit, has a cam motion which oscillates a cutter mounted on a steel rocking-knife which cuts on both sides. In order to prevent the splintering of the wood, the ends of the cutter are provided with small semi-circular shaped saws, which help in cutting out perfectly square corners. It is estimated that this new process will save the labour of three men who work with chisels, as one man can conveniently cut a 2-in. mortise in the same length of time he can bore a round hole.—*Iron.*

The Preservation of the Thames.—On Tuesday a Bill prepared by the members of the Committee who took evidence as to the "operation of the Acts for the preservation of the Thames, and the steps necessary to secure the enjoyment of the river as a place of recreation," was issued. The object of the Bill is to preserve the Thames above Teddington Lock for purposes of public recreation, and for regulating the pleasure traffic thereon. It asserts a public right of navigation, but private artificial cuts are not to be deemed parts of the river. The Conservators may exclude the public. The right of navigation is to include anchoring and mooring, and the riparian owner is to remove obstructions unless maintained for twenty years. There is a provision for preventing annoyance to riparian owners, and also against shooting or the use of firearms on the river. All pleasure-boats are to be registered. Jurisdiction for offences against the Act will be exercised by the Justices.

Spring-bank Presbyterian Church, Hull. This church, which has been closed for alterations about two months, was re-opened on Sunday last. The works have been carried out under the superintendence of Mr. Samuel Musgrave, architect, Hull. To remedy acoustic defects, Mr. Musgrave recommended the formation of a false roof, commencing a few feet above the wall-plates, and formed into panels, and boarded with narrow boarding; also the bringing forward of the rostrum or pulpit, and the erection of a semicircular platform behind, on which an organ might be advantageously placed. These recommendations have now been faithfully carried out.

Furness Abbey.—A provincial paper states that the ruins of Furness Abbey were recently in danger of suffering severe damage through the running of heavy mineral trains on the Furness Railway, which skirts the ruins. To avert the danger the Duke of Devonshire, on whose North Lonsdale estate the remains of the abbey are situated, has had the walls of the north transept, the refectorium, chancel, and sacristy supported and strengthened by means of strong stays and tie-rods, and the ruins are now believed capable of resisting the vibration caused by the trains.

The Proposed Woolwich Steam Ferry.—The Secretary of State for War has informed the Woolwich Local Board of Health that he has recommended to her Majesty's Treasury the proposal of the Metropolitan Board of Works to provide a steam ferry at Woolwich as a scheme which ought to receive the support of the Government. To say nothing of the public convenience, the advantages of the intended ferry to the garrison and military stores at Woolwich in the facilities which it will afford for communication with the docks and railways on the opposite side of the Thames are very considerable. The mounted troops and wagons, which have hitherto had a march of eighteen miles from Woolwich, by way of London Bridge, to the Albert Docks, will, when the ferry is at work, have a journey of less than a mile.

The Painters' Company.—Mr. G. Mence Smith has presented a beadle's solid silver-mounted staff to this company. On the top of the staff are the company's arms, enamelled in proper heraldic colours, supported by two leopards rampant, above which is the crest of the company; and surmounting the whole is the figure of St. Luke, the patron saint of the company. Round the ferrule at the top of the staff is the following inscription:—"This staff was presented to the Painters' Company by George Mence Smith, A.D. 1885. John Dibblee Crace (master)." This staff was designed by Mr. J. G. Crace, and manufactured by Messrs. G. Edward & Sons, 1, Poultry. The staff was presented at a banquet given on Wednesday evening last, at the Hall of the Company, Little Trinity-lane.

Val de Travers Asphalte Paving Company.—The fifteenth ordinary general meeting of this company was held on the 25th ult., Mr. H. C. Scott presiding. In their report the directors recommended a dividend of 7s. 6d. per share, making, with the interim payment, 12s. 6d. for the year, and the carrying forward of 2,061*l.* 10s. 3d. to the next account. The Chairman moved the adoption of the report, and in doing so said there had been a considerable improvement on the previous year, and the directors were able to pay an increased dividend. The gross profit of the year was 16,886*l.* 8s. 6d., as against 15,103*l.* 4s. 2d. in 1883, the increase having been gained at the same rate of expense. Mr. James Edmeston seconded the motion, and the report was adopted.

Proposed Extension of Aske's, Hatcham, Schools.—In connexion with these schools, of which the Haberdashers' Company are governors, it has been provisionally agreed that the managers shall be empowered to borrow a sum not exceeding 23,000*l.*, to be gradually replaced out of income, with a view to adapt the buildings, at present used as a girls' school, for the purposes of a lower department of the boys' school, and to purchase land upon which to erect commodious new buildings in which to educate the girls. Upon the completion of the enlargement of the schools there will be accommodation for 500 boys and 400 girls, instead of 300 and 200 respectively under existing conditions.

Salford.—The trustees of the Manchester and Salford Savings Bank have purchased a site in the chief thoroughfare of Salford, where they have hitherto rented premises. The designs for the new bank have been prepared by Messrs. Medland & Henry Taylor, architects, and the work has been let to Mr. Thomas Scott. The architectural character of the proposed work is Italian. The chief front will be in thin Ruabon red bricks, with dressings of stone and terra cotta. The interior of the Bank proper will be of Cliff's glazed bricks. Besides the bank there is to be extensive cellaring,—much of it fireproof,—and five good rooms, all fronting the main street.

Obituary.—The death is announced of Mr. Henry C. Harris, A.R.I.B.A., which took place after a painful and protracted illness, at his residence, "Kingscote," Penarth, on the 18th ult. The deceased was in this thirty-fourth year. He designed and carried out several buildings in Cardiff, Penarth, Bridgend, Maesteg, Pontypridd, and other places, most of which were won in open competition. At Penarth he held the office of Surveyor to the Board of Health from its commencement.

Winchester Cathedral.—At a meeting of the Dean and Chapter of Winchester last week Mr. Sedding was appointed the architect for the restoration of the great screen in Winchester Cathedral.

Arbroath.—A four-light Munich stained-glass window has just been erected in St. Mary's Church, Arbroath, the gift of Mr. and Mrs. Muir, of Abbey Bank. It occupies the west end of the church, and consists of four lights with elaborate tracery. The leading features of the window are large-sized figures of St. Paul, St. Peter, St. Andrew, and St. John, while under each apostle is a small subject descriptive of a scene in his life. The artists are Messrs. Mayer & Co.

Ventilation at the Law Courts.—It is admittedly difficult to please every one, and the question of ventilation appealing to various susceptibilities is rendered none the less easy when the occupants of a room are removed from time to time, as is the case at the New Law Courts, where much remonstrance has recently been occasioned by more than one judge. It appears that the ideas in the judicial mind as to what constitutes a pleasant temperature vary some ten degrees, and the officials of the Office of Works, who have charge of the ventilating arrangements, are frequently called upon at short notice to raise or lower the temperature accordingly. The rule adopted for regulating the work is to know in the evening which (particular!) judge will sit in such and such a court on the following morning, and to arrange the necessary warmth to suit, but as the judges change courts during the day, a further alteration has to be made, hence the individual dissatisfaction. There are nineteen courts to be thus attended to, and the rapid displacement of air is expected to be brought about without draught or inconvenience, and accordingly the principle of the whole system is condemned, one judge going so far as to enjoin that the apertures should be pasted up, in the hope that it would disarrange the entire scheme, and that no attempt should be made to ventilate his court at all. This is an unfair tax upon science, or rather a hopeless attempt to make natural causes immediately subservient to several conditions at one time.—*Sanitary Record.*

Excavations in the Roman Forum.—A telegram to the *Times*, dated Rome, March 31, announces that a very important discovery has been made in connexion with the topography of the Forum. In dressing and carrying back as far as possible the escarpment of the accumulation on the unexcavated portion of the north-east side, on which stands, between the Temple of Antoninus and Faustina and the Church of St. Adriano, that row of modern buildings which is ultimately to be removed for the completion of the excavations, a part of the pavement of the ancient street connecting the Forum with the Suburra has been uncovered. It lies at a level of some 18 in. below the flagged area of the Forum, which, it must be remembered, is that of the seventh century at the earliest. The street extends along the south-east side of that part of the Curia which is now the Church of S. Adriano. The pavement is in a fine state of preservation, and on one side of the street stands a large pedestal, probably of a statue dedicated, as the inscription shows, to the Emperor Constantinus the Second by Memmius Vitrasius Orfitus, who was Præfectus Urbis from 355 to 359. The point at which the end of this street touches the area of the Forum is still covered with *débris* and an extraordinary quantity of masses of marble, such as pedestals of columns, pieces of cornice, and other fragments, found lying heaped upon one another beneath the accumulation removed on the carrying back of the escarpment some 10 ft. or 12 ft.

London Bridge.—The Comptroller of the Bridge-house Estates announces that, on and after Monday, the 13th inst., London Bridge will be partially closed for the purpose of repaving. During the execution of the work provision will be made for keeping open two lines of traffic, one leading to the City and the other to Southwark.

CONTRACTS AND PUBLIC APPOINTMENTS.

Epitome of Advertisements in this Number.

CONTRACTS.

Nature of Work, or Materials.	By whom required.	Architect, Surveyor, or Engineer.	Tenders to be delivered.	Page.
York Paving, &c.*	Vestry Mile End	J. M. Knight	April 7th	xix.
Jobbing Sewers Work*	do.	do.	do.	xix.
Erection of Shops, Hastings	.....	A. Wills	April 9th	ii.
Materials (Navy Contracts)	Admiralty	*Official*	April 10th, &c.	ii.
Erection of Engine-House, &c.	Atherstone Rural Sanitary Authority	Baldwin Latham, M.Inst.C.E.	April 11th	ii.
Construction of Reservoir, &c.				
Cast-Iron Pipes, &c.				
Engines and Pumps, &c.				
Concrete and Tar Pavement	Lowestoft Imp. Com.	R. H. Inch	do.	ii.
Removal of Human Remains, &c.	Met. Board of Works	*Official*	April 13th	ii.
Cast-Iron Pipes	S.W. Sub. Wtrwks Co.	do.	do.	ii.
Making-up and Sewering, Factory-road	West Ham Local Brd.	Lewis Angell	April 14th	xix.
Dust Shoots	do.	do.	do.	xix.
Making-up and Paving Roadways, &c.	Willesden Local Board	O. Claude Robson	do.	ii.
Pumps, Engines, and Sludge Presses	do.	do.	do.	ii.
Roads and Sewers, Chatto's Estate, Clapham Common	.....	W. N. Dunn	do.	ii.
Erection of Public Mortuary	Vestry of St. Giles, Camberwell	*Official*	April 15th	ii.
Alterations, Huddersfield County Court	Com. of H.M. Works	do.	do.	ii.
Construction of Water-Closets, Lavatories, &c.	Grdns. St. Olave's Un.	H. Saxon Snell & Son	April 16th	ii.
Main Drainage Works	Compton Gifford Lcl. B.	*Official*	do.	xix.
Wood Paving	Birmingham Public Works Committee	W. S. Till	April 20th	xix.
New Works to Parish Church, Eastington	The Committee	Waller, Son, & Wood	April 22nd	xix.
New Church, Longton, Lancashire	.....	J. E. K. Cutts	Not stated	ii.
Erection, &c., of Small Houses	.....	E. S. & H. Boosey	do.	ii.
Erection of Corn Exchange	Abingdon Corporation	Chas. Bell	do.	ii.

* Time for receiving Tenders has been altered from THREE p.m. to TEN a.m.

PUBLIC APPOINTMENTS.

Nature of Appointment.	By whom Advertised.	Salary.	Applications to be in.	Page.
Assistant, Borough Surveyor's Office	Reading Corporation	Not stated	April 14th	xvi.
Clerk of Works	Wellngtn (Somerst) L. B.	do.	April 21st	xvi.

TENDERS.

For sewage outfall works at Silvertown, Essex, for the West Ham Local Board. Mr. Lewis Angell, C.E., engineer. Quantities by Messrs. R. L. Curtis & Son :—

Dierden & Co.	£14,414 0 0
J. Greenwood	13,800 0 0
W. J. Botterill	12,998 0 0
Munday & Son	12,675 0 0
Mowlem & Co.	12,485 0 0
G. Bell	12,280 0 0
J. W. & J. Neave	11,936 0 0
W. Webster	11,924 0 0
J. J. Robson	11,395 0 0
T. Adams	10,998 0 0
W. Gregar	10,830 0 0
S. Chafen	10,656 0 0
B. Cooke & Co., Phœnix Wharf, Church-road, Battersea*	10,464 0 0

* Accepted.

For additions to the Trossachs public-house, with two shops adjoining, in the Barking-road, for Mr. G. W. Kidd. Mr. G. More, architect. Quantities by Messrs. Curtis & Sons :—

	Main Building.	Repairs.	Old Materials.
Nye	£3,344	£194	£55
Gregar	3,137	220	38
Hearle	3,903	198	10
Morter	3,075	250	30
Lamble	2,856	163	50
Jackson & Todd*	2,700	175	25

* Accepted.

For works at High-street, Epping, for Mr. Harrison. Mr. E. Boyce, surveyor :—

Davis, Epping	£173 10 0
Palmer Bros. & Wiffin, Epping	143 17 0
G. Bulford, Kingsland	139 15 0

For the completion of five houses at Oxford-road, Wallington, Surrey. Mr. Thomas Spearing, surveyor, Beaconsfield-terrace, St. John's-road, Clapham-junction :—

H. Brown, Wandsworth	£950 0 0
Wm. Ellis, Clapham	950 0 0
J. Dickeson, Battersea	875 0 0
A. H. Harris, Sutton	840 0 0
G. Collis, Wandsworth	775 0 0
F. Warr, Croydon	693 0 0
J. Myring, Wandsworth	609 0 0
J. Stapleton, Wandsworth	599 10 0
Chas. Matkin, Kensington	589 0 0
Horne, Fenn, & Co., Guildford	567 0 0
Couzins & Co., Camberwell	537 11 0

For two shops, dwelling-houses, and outbuildings, at Crossbrook-street, Cheshunt :—

Sanders	£1,631 0 0
White	1,565 0 0
Bunce	1,460 0 0
Archer	1,455 0 0
Hart	1,332 0 0
Lawrence	1,331 0 0
Boswell (part accepted)	1,225 1 0
Holding	1,010 0 0

For erection of two houses at Gray's Inn-road. Mr. W. Ansell, architect :—

Patman & Fotheringham	£3,362 0 0
Wm. Brass & Son	3,280 0 0
J. Anley	3,260 0 0
Lawrence & Son	3,228 0 0
Macey & Son	3,131 0 0
Scrivener & Co.	3,109 0 0
Wm. Downs	3,037 0 0
W. Shurmur	2,988 0 0
S. Godden	2,898 0 0

Accepted for works at Bermondsey, for Mr. Davies. Mr. H. G. Bailey, surveyor :—

Bulford, Kingsland	£180 0 0

[No competition.]

For stabling, &c., situate at Hurlingham-lane, Fulham, for the London General Omnibus Company, under the superintendence of Mr. G. T. Lanham. Quantities by Mr. Bolton :—

Jackson & Todd	£1,100 0 0
Haynes	1,025 0 0
Richens & Mount	982 0 0
Aldridge & Jenvey	965 0 0
Garrud	951 17 0
Evans	939 0 0
Howell & Son	937 0 0
Parker	935 0 0
Knight	902 0 0
Hunt (accepted)	886 0 0
Dearing & Son	871 9 0

For new stable, shed, and alterations to Gateway House, situate at Estcourt-road, Fulham, for the London General Omnibus Company, under the superintendence of Mr. G. T. Lanham. Quantities by Mr. Bolton :—

	Stables. £ s. d.	House. £ s.	Totals. £ s. d.
Hack	1,093 0 0	205 0	1,298 0 0
Jackson & Todd	975 0 0	195 0	1,170 0 0
North Bros.	997 0 0	155 0	1,152 0 0
Evans	954 0 0	144 0	1,093 0 0
Richens & Mount	932 0 0	163 0	1,095 0 0
Garrud	879 15 6	197 17	1,077 12 6
Hunt	899 0 0	177 0	1,076 0 0
Haynes	970 0 0	100 0	1,070 0 0
Howell & Son	890 0 0	175 0	1,065 0 0
Parker	886 0 0	139 0	1,025 0 0
Knight	870 0 0	150 0	1,020 0 0
Dearing & Son	814 0 0	158 10	972 10 0
Aldridge & Jenvey	815 0 0	118 5	933 5 0

For partially rebuilding No. 204, Upper-street, Islington. Mr. Richard J. Lovell, architect. Quantities by Mr. C. Stanger :—

Colls	£732 0 0
Greenwood	670 16 0
L. H. & H. Roberts	645 0 0
Grover	620 0 0
Dove Bros.	611 10 0
Combes & Son	566 0 0

For the erection of new Board Schools at Claygate, Surrey, for the Thames Ditton School Board. Mr. Richard J. Lovell, architect, 63, Finsbury-pavement. Quantities by Mr. James Kennedy, Guildford-street :—

Martin, Addlestone, Surrey	£4,810 0 0
Home, Clapton	4,646 0 0
Oldridge, Norbiton, Surrey	4,441 0 0
Clark, Esher	4,408 12 6
Staines & Son, London	4,376 0 0
Woodbridge, Maidenhead	4,300 0 0
Woolgar, Horsham	4,200 0 0
Parker, Peckham	4,200 0 0
Croaker, Borough	4,170 0 0
Jarvis, Surbiton-hill	4,065 0 0
Holt, Croydon	4,000 0 0
Holloway, Lavender-hill	3,996 0 0
Bonell, Teddington	3,975 0 0
Carless, Richmond	3,967 0 0
P. Peters, Horsham	3,950 0 0
Stephenson, Hampstead	3,857 0 0
Wells, Kingston-on-Thames	3,850 0 0
Wheatley, East Moulsey	3,840 10 0
Lorden, Upper Tooting	3,830 0 0
Collinson, Teddington	3,795 0 0
Hann & Co., Windsor	3,789 0 0
J. Piller, Teddington	3,670 0 0
F. Peters, jun., Oatlands Park	3,578 10 0
Babbs Bros., Surbiton-hill	3,490 0 0

For the erection of two villa residences at Hadley-road, Barnet. Mr. H. F. Brown, architect :—

Daniels, Barnet	£1,386 14 6
Knight & Son, Tottenham	1,148 0 0
Reed, Walthamstow	940 0 0

For new business premises at 23, Bermondsey New-road :—

Canning & Mullins	£2,317	0	0
Lidstone & Son	2,080	0	0
Shepherd	1,850	0	0
Battley	1,849	0	0

For repairs at the Licensed Victuallers' Asylum, Asylum-road, Old Kent-road. Mr. W. F. Potter, architect :—

R. Maskall, Hoxton	£302	10	0
E. F. Walesby, Hoxton	254	0	0
W. Buckle, Stratford	200	0	0
B. Cook, Stonecutter-street	188	0	0
S. Hayworth & Sons, Kingsland	175	0	0
C. Dearing & Son, Islington	157	0	0
F. & C. Hersee, Peckham	154	0	0
W. Wythe, Dalston (accepted)	115	0	0

Accepted for the third section of the Colne Valley sewer, for the Birmingham Town Council :—

Bottoms Bros., Battersea	£5,327	0	0

Accepted for a pair of houses, Brunswick-road, Sutton, Surrey. Mr. Herbert D. Appleton, architect, Wool Exchange, E.C. :—

W. Robinson	£1,085	0	0

For the erection of Turkish baths, Earl's Court-gardens, Earl's-court, London, for Mrs. Thomas. Messrs. T. L. Banks & Townsend, architects. Quantities by Mr. J. Sargeant :—

T. Richards	£1,364	0	0
Lucas & Son	1,044	0	0
J. Beale & Son	1,032	0	0
C. Maton	993	0	0
H. Smith & Son	970	0	0
Turtle & Appleton	955	0	0
A. Doughty	934	0	0
W. H. Smith	9.5	0	0

For building first section of Cowleigh Schools, near Malvern. Mr. Henry Haddon, architect :—

Thomas Broad	£915	0	0
William Porter	911	0	0
John Everal	891	19	0
John Inwood (accepted)	870	0	0

[All of Malvern.]

For erecting business premises, Nos. 8, 9, 10, 11, and 12, Lovell's-court, Paternoster-row. Mr. W. H. Scrymgour, architect, 50, Lincoln's Inn-fields :—

W. Shepherd	£8,844	0	0
Turtle & Appleton	6,750	0	0
Barrie Bros.	6,697	0	0
Nightingale	6,683	0	0
Anley	6,550	0	0

For new offices and additions to factory at Vauxhall, for Messrs. Barrett & Co. (Limited). Contract No. 3. Mr. Edward Rawlings, architect, 3, Victoria-street, Westminster. Quantities by Mr. Morris Evans, 7, John-street, Adelphi :—

C. Dickinson, Loughboro'-junction	£800	0	0
Fish, Prestige, & Co., Pimlico	795	0	0
H. & E. Lea, Warwick-street	780	0	0
G. Stephenson, Hampstead	748	0	0
F. Higgs, Loughboro'-junction	720	0	0

For new schools, class-rooms, and other buildings adjoining Congregational Church, Leytonstone, Essex. Mr. James Cubitt, architect :—

Egan	£2,886	0	0
Dobson	2,748	0	0
Cook	2,451	0	0
Johnson	2,430	0	0
Morter	2,387	0	0
Reed	2,333	0	0
Gregar	2,330	0	0
J. Catley (accepted)	2,246	0	0

For erection of additional vestry, &c., at Christ's Church, Enfield. Mr W. D. Church, architect :—

Patman	£1,319	0	0
Thompson	1,295	0	0
Steel Bros.	1,199	0	0
Richardson	1,198	0	0
W. Shurmur	1,188	0	0
Staines & Son	1,166	0	0
Fairhead	1,079	0	0
Mills	1,057	0	0
Tinson	998	0	0

For the erection of a vicarage-house at Wealdstone Harrow, Middlesex. Mr. H. Roumieu Gough, architect, No. 12, Carlton-chambers, Regent-street. Quantities by Mr. Charles H. Gough :—

G. Kirby & Co.	£2,210	0	0
S. Odell & Lett	2,127	16	10
J. Brown, Son, & Blomfield	2,050	0	0
J. Larter	1,970	0	0
Gregory & Bence	1,900	0	0
C. P. Mills	1,793	0	0
Chamberlain Bros.	1,793	0	0
J. Lister	1,765	0	0
D. Belham & Co.	1,693	0	0
Thos. Wontner Smith & Son	1,670	0	0

For the erection of a cottage, Mersea road, Colchester, for Mr. R. Salmon. Mr. G. H. Page, architect, Colchester :—

Eade	£168	0	0
Harden	167	10	0
Ambrose	164	0	0
Bowles	149	18	6
Chambers	149	0	0
Putt	147	0	0
Gladwell (accepted)	137	0	0

SPECIAL NOTICE.—Lists of Tenders frequently reach us too late for insertion. They should be delivered at our Office, 46, Catherine-street, W.C., *not later than Four p.m.* on THURSDAYS.

TO CORRESPONDENTS.

J. E. (Stuttgart).—J. P. (Madrid).—W. S. (shall have attention).—R. F. (thanks).—A. S. C.—M. T.—E. J. T.—W. H. S.—A. C. (we can only discuss the question in general principle; if we were to begin to go into special cases in that way we should get into a complicated correspondence which would only confuse the main question).—H. D. (cannot go into so old a matter now).—J. L. P. (amounts of tenders must be given).—"An Amateur" (no name and address given. We entirely agree with the opinion you express, but it would be hopeless to attempt to re-open the matter).—T. E. K. (too late, as we have to go to press a day earlier than usual this week).—"A Sufferer" (letters cannot be published unless authenticated with name and address).

All statements of facts lists of tenders, &c., must be accompanied by the name and address of the sender, not necessarily for publication.

We are compelled to decline pointing out books and giving addresses.

NOTE.—The responsibility of signed articles, and papers read at public meetings, rests, of course, with the authors.

We cannot undertake to return rejected communications.

Letters or communications (beyond mere news-items) which have been duplicated for other journals, are NOT DESIRED.

All communications regarding literary and artistic matters should be addressed to THE EDITOR; all communications relating to advertisements and other exclusively business matters should be addressed to THE PUBLISHER, and *not* to the Editor.

PUBLISHER'S NOTICES.

CHARGES FOR ADVERTISEMENTS.

SITUATIONS VACANT, PARTNERSHIPS, APPRENTICESHIPS, TRADE, AND GENERAL ADVERTISEMENTS.

Six lines (about fifty words) or under ..... 4s. 6d.
Each additional line (about ten words) ..... 0s. 6d.

Terms for Series of Trade Advertisements, also for Special Advertisements on front page, Competitions, Contracts, Sales by Auction, &c. may be obtained on application to the Publisher.

SITUATIONS WANTED.

FOUR Lines (about THIRTY words) or under ..... 2s. 6d.
Each additional line (about ten words) ..... 0s. 6d.

PREPAYMENT IS ABSOLUTELY NECESSARY.

*** Stamps *must not* be sent, but all small sums should be remitted by Cash in Registered Letter or by Money Order, payable at the Post-office, Covent-garden, W.C. to

DOUGLAS FOURDRINIER, Publisher,
Addressed to No. 46, Catherine-street, W.C.

Advertisements for the current week's issue must reach the Office before THREE o'clock p.m. on THURSDAY.

The Publisher cannot be responsible for DRAWINGS, TESTIMONIALS, &c. left at the Office in reply to Advertisements, and strongly recommends that of the latter COPIES ONLY should be sent.

SPECIAL.—ALTERATIONS in STANDING ADVERTISEMENTS or ORDERS TO DISCONTINUE same, must reach the Office before TEN o'clock on WEDNESDAY mornings.

PERSONS Advertising in "The Builder," may have *Replies addressed to the Office*, 46, Catherine-street, Covent-garden, W.C. *free of charge*. Letters will be forwarded if addressed envelopes are sent, together with sufficient stamps to cover the postage.

TERMS OF SUBSCRIPTION.

"THE BUILDER" is supplied DIRECT from the Office to residents in any part of the United Kingdom at the rate of 19s. per annum, PREPAID. To countries within the Postal Union, 26s. per annum. Remittances payable to DOUGLAS FOURDRINIER, Publisher, No. 46, Catherine-street, W.C.

Best Bath Stone.
WESTWOOD GROUND,
Box Ground, Combe Down,
Corsham Down,
And Farleigh Down.
RANDELL, SAUNDERS, & CO., Limited,
Corsham, Wilts. [ADVT.

Bath Stone.
ALL DESCRIPTIONS OF BEST QUALITY.
PICTOR & SONS,
BOX, WILTS. [ADVT.

Doulting Freestone and Ham Hill Stone of best quality, in blocks, or prepared ready for fixing. An inspection of the Doulting Quarries is respectfully solicited; and Architects and others are CAUTIONED against inferior stone. Prices, delivered to any part of the United Kingdom, given on application to CHARLES TRASK & SONS, Norton-sub-Hamdon, Ilminster, Somerset.—Agent, Mr. E. WILLIAMS, No. 16, Craven-street, Strand, W.C. [ADVT.

Doulting Free Stone
HAM HILL STONE,
BLUE LIAS LIME
(Ground or Lump),
For prices, &c., address S. & J. STAPLE, Quarry Owners, Stone and Lime Merchants, Stoke-under-Ham, Ilminster. [ADVT.

Asphalte.—The Seyssel and Metallic Lava Asphalte Company (Mr. H. Glenn), Office, 38, Poultry, E.C.—The best and cheapest materials for damp courses, railway arches, warehouse floors, flat roofs, stables, cow-sheds, and milk-rooms, granaries, tun-rooms, and terraces. [ADVT.

Asphalte.
Seyssel, Patent Metallic Lava, and White Asphaltes.
M. STODART & CO.
Office:
No. 90, Cannon-street, E.C. [ADVT.

EVERY DESCRIPTION OF SEASONED WOODS AND VENEERS IN EXTENSIVE QUANTITIES.
B. J. HUDSON & SONS,
Whitfield-street, W.
Store-street, W.C., and
Great Peter-street, S.W., London.
Telephone No. 3,654, and Private Wire connecting Business Premises.

MICHELMORE & REAP,
Manufacturers of
CHARLES COLLINGE'S PATENT.
COLLINGE'S PATENT HINGES,
LEVER, SCREW, & BARREL BOLTS,
Self-Acting "FALL DOWN" GATE STOPS,
and IMPROVED GATE FITTINGS of every Description,
36A, BOROUGH ROAD,
LONDON, S.E.
DISCOUNT TO BUILDERS.

GOLD AND SILVER MEDALS AT AMSTERDAM EXHIBITION.
IRON CISTERNS.
F. BRABY & CO.
LONDON, LIVERPOOL, GLASGOW.
VERY PROMPT SUPPLY.
LARGE STOCK READY.
CYLINDERS FOR HOT-WATER CIRCULATION.
Particulars on application. *Chief Office: 360, EUSTON ROAD, LONDON.*

ZINC ROOFING,

CORRUGATED IRON ROOFING

(FIXED COMPLETE).

GALVANISED IRON

OPEN CISTERNS

AND

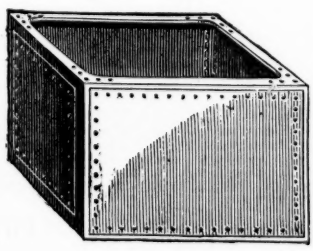
CLOSE TANKS

KEPT IN STOCK;

ALSO

MADE TO ORDER

IN ANY SIZE.



ESTIMATES ON APPLICATION TO

The OLDEST FIRM IN THE TRADE,

TREGGON

& CO.,

YORK WORKS,

BREWERY ROAD,

LONDON, N.,

AND

19, JEWIN STREET, E.C.

SEND FOR NEW CATALOGUE.

EASTWOOD & CO.

LIMITED.

Lime, Cement, & Brick Manufacturers

SHOEBURY, COWLEY, AND KENT BRICKS, IN ANY QUANTITY, DELIVERED ALONGSIDE.

Shoebury Malm Facings and Paviors.
Stourbridge, Welsh, & Newcastle Fire Bricks, &c.
Glazed and other Drain Pipes.
Dutch Adamantine and Red English Clinkers.
Red and White Suffolk Bricks.
Moulded Bricks of all kinds.
Red, White, and Black Rubbers.

Greystone, Blue Lias, and Chalk Lime.
Laths, Plaster.
Broseley and Yorkshire Roofing Tiles.
Ridge Tiles, Terminals, &c.
Staffordshire Blue Bricks.
Chimney Pots, Slates.
Hair Sand, &c.

PORTLAND CEMENT

(WELLINGTON BRAND) of unsurpassed quality.

SOLE LONDON CONSIGNEES OF MESSRS. GIBBS & CO.'S (WEST THURROCK) PORTLAND CEMENT AND THE LUMLEY GLAZED BRICKS.

BRICKFIELDS:—

West Drayton, Middlesex. | Sittingbourne, Kent.

WHARFS:—

Wellington Wharf, Belvedere-road, Lambeth.
Canal Bridge Wharfs, Old Kent-road, S.E.
Chelsea Wharf, Lot's-road, Chelsea.
Kensal Green, Harrow-road.
Victoria Wharf, Mortlake, S.W.; and
Black Horse-lane, Richmond.

ROCK

LIFE ASSURANCE COMPANY,

15, New Bridge-street, Blackfriars, London, E.C.

ESTABLISHED 1806.

THE Accumulated Fund considerably exceeds **Three Millions Sterling.** Upwards of **Nine Millions** already paid in Life Claims, and **Three Millions** divided in profits among the Policy-holders.

ABSOLUTE SECURITY. NO INDIVIDUAL LIABILITY.
LIBERAL CONDITIONS FOR FOREIGN RESIDENCE. IMMEDIATE PAYMENT OF CLAIMS.
SPECIAL CONCESSIONS FOR MILITARY AND NAVAL SERVICE.

Whole World Policies suitable for Securities granted on very favourable terms.

Liberal Surrender Values. Family Settlement and Trust Policies. Partnership Assurances, to supply capital in the event of retirement or death of partner.

Investment Policies a special feature of the Company, embodying **Non-Forfeiture** with **Large Returns. Limited Premiums** and Table of **Liberal and Fixed Surrender Values printed upon each Policy.**

Annuities granted, and also Loans on approved securities.

For the New Prospectus of the Company, and all requisite information, apply to the Actuary at the Chief Office.

GEORGE S. CRISFORD, *Actuary.*

ROCK CONCRETE TUBES,

FOR MAIN SEWERS, &c., from 15 inches to 36 inches in diameter.

SOLE MAKERS:

HENRY SHARP, JONES, & CO.

BOURNE VALLEY WORKS, POOLE, DORSET.

LONDON AGENTS:—

Messrs. BOWES, SCOTT, & READ, Broadway Chambers, Westminster.

MANUFACTURERS OF THE BEST CLASS OF HARDWOOD JOINERY FOR BANKS, OFFICES, MUSEUMS, LIBRARIES, BUFFETS, &c &c
FRED.K SAGE & COMP.Y
DESIGNS & ESTIMATES SUBMITTED
80 TO 84, GRAYS INN ROAD, LONDON
SHOP FRONT BUILDERS
SHOW CASE MAKERS.
FITTINGS OF EVERY DESCRIPTION
THE LARGEST STOCK OF NEW & SECOND HAND SHOW CASES IN THE WORLD.
WALL CASES, CENTRE CASES, COUNTER CASES, &c &c
SAGES SHOP FRONTS
STAINED
PRIZE MEDALLISTS AT THE LONDON, VIENNA PHILADELPHIA & CAPE OF GOOD HOPE EXHIBITIONS
GLASS.
SHOW CASE MAKERS TO THE PRINCIPAL MUSEUMS IN ENGLAND & THE COLONIES.
BUFFET
BANK SCREEN

THE "BUILDER" in AMERICA.—SUBSCRIPTION, for any time, at PUBLICATION PRICE, can be made with B. F. STEVENS, 4, Trafalgar-square, Charing-cross, London. The Annual Subscription, including Postage, is 1*l.* 6*s.* 0*d.* or $6·33 Gold, and may be remitted direct, or paid to the New York Agents of B. F. STEVENS, Messrs. TICE & LYNCH, 34*½*, Pine-street, New York.

LOWER THAMES VALLEY MAIN DRAINAGE.
SCHEME on the SHONE HYDRO-PNEUMATIC SYSTEM submitted to the Local Government Board and the Lower Thames Valley Joint Board. Price 1*s.*
Messrs. E. & F. N. SPON, 125, Strand, London, W.C.

NOW READY, price 4*s.*
LAXTON'S
BUILDER'S PRICE BOOK,
FOR 1885,
Containing about 72,000 prices for the use of Architects, Surveyors, and Contractors; the Act, with notes of cases, &c., on the Building Act. Laxton is the acknowledged standard to which, in disputed cases in the various Law Courts, reference is made.
London: KELLY & CO., 51, Great Queen-street, W.C. and SIMPKIN, MARSHALL, & CO. Stationers Hall-court, E.C.

Just published.—Second Annual Issue, royal 8vo. cloth, price 3*s.*
ARCHITECT and CONTRACTOR'S HANDBOOK (The) and Illustrated Catalogue of Materials and Manufactures for 1885.
Edited by J. DOUGLASS MATTHEWS, F.R.I.B.A. F.S.I.
A most useful book of reference, containing a concise description of upwards of 800 Manufactures and Materials used in Building, arranged under thirty-four classes, together with the Names and Addresses of the Merchants, and an Index to Materials. Invaluable to Architects, Surveyors, Contractors, &c.
B. T. BATSFORD, Architectural and Scientific Bookseller and Publisher, 52, High Holborn, London, W.C.

Will shortly be published, royal 4to, with 85 plates, price 2*l.* 10*s.*
Two guineas to subscribers.
ART and WORK. Consisting of about 550 choice examples of Antique, Italian, Renaissance, "Adam," Oriental, and Modern Work in Marble, Stone, Metal, Wood, Colour, &c, Illustrated and described by
OWEN W. DAVIS, Architect,
No. 1, Caroline-street, Bedford-square, London, W.C.
Prospectuses on application, to complete the list of 300 Subscribers.

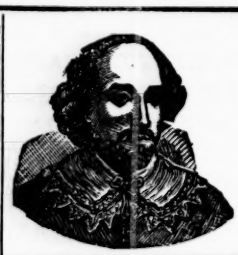
TO BOOK BUYERS and LIBRARIANS of FREE LIBRARIES.—The APRIL CATALOGUE of valuable NEW and SECOND HAND WORKS, offered at Prices greatly reduced, is now ready, and will be sent post-free upon application to W. H. SMITH & SON, Library Department, 186, Strand, London, W.C.

TO SIGN PAINTERS and ORNAMENTAL WRITERS.—H. D. SMITH'S Manual of Plain and Ornamental Alphabets, Ancient and Modern, for the use of Engravers and Ornamental Writers, may be had, post-free, price 1*s.* 6*d.*—London, ALLMAN & SON, 67, New Oxford-street, W.C.

HAMPDEN RESIDENTIAL CLUB.
President.—VISCOUNT HAMPDEN.
All the advantages of a home and club. Subscription, One Guinea a year, or 6*s.* per quarter.
Bedroom, 7*s.* per week, including use of all common rooms.
For Prospectus, apply to Secretary, 156, Osnaulston-street, Euston-road, London, N.W.

ELECTRICAL POWER STORAGE COMPANY, LIMITED.
Offices: 4, Great Winchester-street, E.C.
Works: Millwall, E.
Telephone Nos. { Office, 338. Works, 5,116.
Registered Telegraph address: "Storage," London.
ELECTRIC LIGHT ENGINEERS AND CONTRACTORS.
SOLE MANUFACTURERS of the "E. P. S." ACCUMULATOR, which ensures absolute steadiness and prevents failure in Electric Light; enables lamps to burn at any hour, day, or night, when engines are not running, thus combining, with the excellence and beauty of the Electric Light, the convenience of gas. This renders it especially suitable for Hotels, Mansions, Country Residences, Factories, and Mills.
Portable Electric Light Plant for temporary Installations, such as Building Operations, Public or Social Meetings, Fêtes, Balls, Dinners, &c.
Estimates free on application.

TO the ARCHITECTS of the UNITED KINGDOM.
Mr. FREDERICK HENRY SMITH, of No. 52, Queen Victoria-street, E.C. Inventor, Patentee, and Sole Proprietor of the Patent Automatic Aspirator System of Ventilation, Lighting and Heating, finding it beyond his power to attend to the many applications to apply his System of Ventilation in so many different parts of the country, without increasing his staff, has been advised by an eminent architect to appoint Agencies in the counties of the United Kingdom, whose duty it will be to prepare plans, specifications, and estimates, and to superintend all works, where the Syphonic Aspirator System may be applied.
For further particulars, terms, &c. apply in the first instance by letter (only) at the address of the Patentee above given.



BILLS OF QUANTITIES, &c.,
CORRECTLY WRITTEN AND LITHOGRAPHED BY
RETURN OF POST CERTAIN.
J. L. ALLDAY,
Shakespere Printing Works, Birmingham.

KING'S COLLEGE WORKSHOPS EVENING CLASSES.
SUMMER TERM will COMMENCE on TUESDAY, APRIL 7th, at HALF-PAST SIX p.m.
Course of Instruction and Practical Work suited for Engineers, Architects, Colourists, Gentlemen Amateurs and Others.
Staff of Eight skilled Instructors, with plant of Steam Machinery.
For prospectus apply,
J. W. CUNNINGHAM, Esq.
King's College, London.

THE ASSISTANCE of CAPITALISTS is DESIRED to utilise a waste product, which, by an important discovery, becomes a most valuable article of consumption. Extraordinary profits must unquestionably result immediately. The opportunity is exceptional and thoroughly genuine.—INDUSTRY, Palace Chambers, Westminster, S.W.

COLWELL & HAZLE,
PILE DRIVERS AND CONTRACTORS,
No. 2, Plough-road, Rotherhithe, S.E.
(REMOVED FROM 4 and 5, THREE CROWN SQUARE, E.C.
City Office: 13, King-street, Cheapside, E.C.

TO ARCHITECTS, SURVEYORS, &c.
OFFICES TO BE LET in High-street (private house in centre of the town), Croydon. Population over 100,000.
Apply, 105, High-street, Croydon.

DRAUGHTSMAN (Engineering) Wanted, in London at once. None need apply unless thoroughly acquainted with designing and arranging woodworking and stone-working Machinery.—Address, Box 277, Office of "The Builder."

BOROUGH of READING.
WANTED, in the Office of the Borough Surveyor, a duly qualified ASSISTANT.
Applications, stating age, occupation, and salary required, with testimonials, to be delivered to me not later than TUESDAY, the 14th of APRIL next.
A. W. PARRY, Borough Surveyor.
Town-hall, Reading, March 30th, 1885.

TRAVELLER WANTED, to call upon firms using steam power, in town and country.—MORIAN, 5, Carey-lane, London, E.C.

TRAVELLER.—WANTED, an experienced MAN, to TRAVEL in the North of England, for Messrs. W. DENISON & SON, Clayfield Brick, Tile, and Sanitary Pipe Works, Mexborough. Commission.—Apply, F. WM. DENISON, 4, Gladstone-street, Hull.

TRAVELLER (experienced) WANTED IMMEDIATELY, accustomed to the building trades. Must have good references.—Apply by letter to J. SESSIONS & SONS, Builders' Factors and General Merchants, Cardiff.

CLERK WANTED, in a Builder's Office. None but good practical men need apply.—S. & S. 14, Loughborough-road, Brixton.

CLERK.—WANTED, in a London Builder's Office, an efficient, competent CLERK, to Take Charge of Estimating, Work up Deviations from Contracts, and Accounts, Measure Piecework, &c.—State age, experience, and salary, Box 276, Office of "The Builder."

JUNIOR CLERK. — WANTED, in a Builder's Office, a CLERK accustomed to the usual routine.—Reply, stating age, salary required, &c. Box 278, Office of "The Builder."

WELLINGTON (SOMERSET) LOCAL BOARD.
WATER WORKS.
The Wellington Local Board require a CLERK of WORKS.
He must reside in the district and devote his whole time.
A knowledge of Water Supply Works indispensable.
Applications, stating age, experience, and salary required, must be sent, under cover, to the undersigned, and endorsed "Clerk of Works," on or before the 21st day of APRIL, 1885.
By order,
W. BURRIDGE, Jun.,
Clerk to the Board.
Wellington, Somerset, 30th March, 1885.

STOREKEEPER and TIMEKEEPER.—WANTED, a competent Man, to Keep Stores of a Corporation Depôt and take workmen's time. Only those with previous experience of these duties need apply. Salary 25*s.* per week.—Applications, accompanied by not more than three recent testimonials, to be sent to Box 266, Office of "The Builder."

AGENTS WANTED, on Commission, for London and different towns of England, to Represent a Belgian Company, proprietors of Marble Quarries, having a perfect knowledge and well acquainted with the trade and builders. References, &c. required.—Address, A. G. 51, Rue du Canal, Brussels.

WANTED, good SCULPTORS and FIGURE MODELLERS, several STONE CARVERS, and FOREMAN of MASONS, capable of Taking Charge of High-class Work.—Apply, HARRY HEMS, Exeter.

CARPENTER WANTED. Thoroughly experienced in Iron Church work. None but those who can make a first-class job of the ironwork as well as carpentering need apply, by letter only.—State wages, and what Iron Church Builders have worked for, to E. F. 2, Derby Houses, Derby-road, West Croydon.

PIECEWORK.—WANTED, Two respectable Men, to take the FIXING and FINISHING of JOINERS' WORK thirty miles from London. Good references required as to ability to carry out work.—Apply, J. 114, Ferndale-road, Clapham.

PLUMBER WANTED at once. A thoroughly steady Man, with a thorough knowledge of pumps, and good at sanitary work and jobbing. Constancy if suitable. State wages.—E. & F. NEWTON, Plumbers, Hitchin.

PLUMBER WANTED, upon a large Estate. Must understand deep-well pumps, hydraulic rams. Must be perfectly sober and trustworthy. Good house and garden found.—Apply, stating age, salary required, and references, to Mr. MATTHEWS, Kedleston, Derby.

THE
LONDON DRAWING OFFICE
AND
ARCHITECTURAL STUDIO.
(LLOYD & CO.)
ESTABLISHED 1878.
37, Great James-street, Bedford-row, W.C.
Managing Director, EDWD. H. LLOYD, Architect and Surveyor.
Cheques crossed LLOYDS, BARNETTS and BOSANQUETS.
Office Hours: 9.30 to 5.30. Saturdays to 2.
The LARGEST, BEST and MOST COMPLETE ORGANISATION for the prompt and efficient preparation of all work usually required by the Profession, as: Surveys; Designs; General, Working, and Detail Drawings; Specifications; Quantities; Competition Work; Perspectives in Etching or Colour; Tracings and Mountings of every description; Plans, &c. on Deeds; Law Writing; Lithoing Bills of Quantities; Photo-Lithography; Illumination; Heraldic Work.
Estimates by return of post on receipt of full particulars.
WORKING DRAWINGS from ROUGH SKETCHES.
Clients may rely upon the greatest care and attention being devoted to the preparation of above.

THE
Drawing and Tracing Office,
COPTHALL HOUSE, TELEGRAPH-STREET,
MOORGATE-STREET, E.C.
Architectural and Engineering Drawings.
Perspectives, either Coloured or Etched.
Tracings of every description made.
Designs prepared in every class of Building.
Working Drawings made from Rough Sketches.
&c., &c.
JOHN B. THORP, Architect.

TO ARCHITECTS. — MANAGING ASSISTANT will shortly be open to a RE-ENGAGEMENT. Sixteen years' practical experience in London and provincial works of every description. Excellent reference.—E. P. 52, St. Donatt's-road, New-cross, S.E.